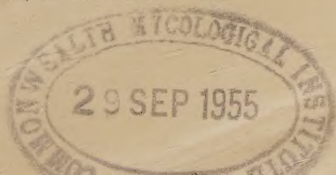


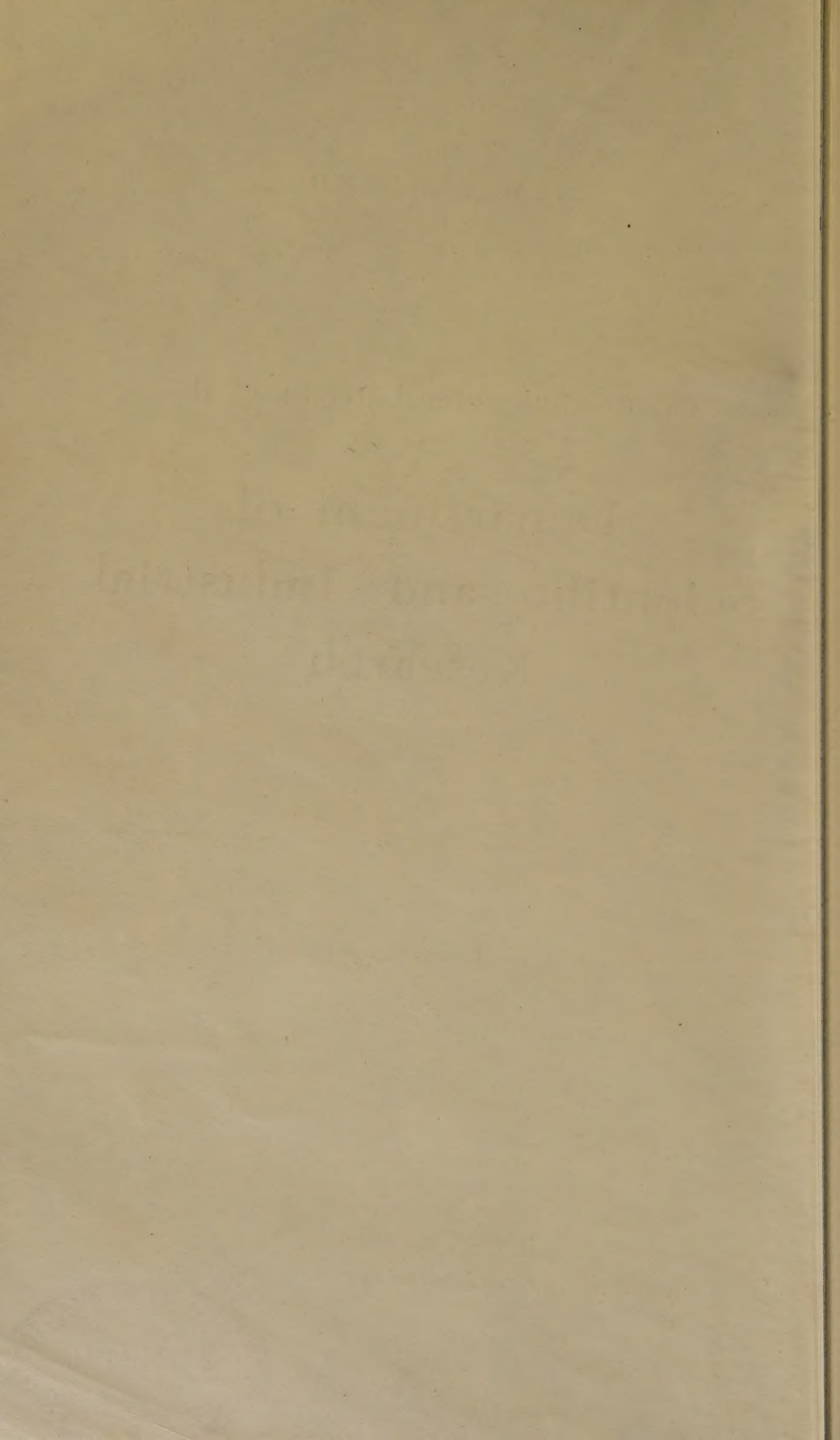
1955
NEW ZEALAND

Twenty-ninth Annual Report of the

Department of
Scientific and Industrial
Research

Presented to the House of Representatives by Leave





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MINISTER'S STATEMENT

THE report of the Department of Scientific and Industrial Research for the financial year ended 31 March 1955 is presented herewith.

Sir Theodore Rigg, Chairman of the Council of Scientific and Industrial Research, did not seek reappointment on the expiry of the term of appointment of the Council in December 1954. Sir Theodore had served continuously on the Council since it was established in 1926 and was appointed Chairman in 1943. I should like to take this opportunity of expressing my thanks in acknowledgment and appreciation of his long and distinguished service to science and the Government. Mr J. Ranstead and Dr R. O. Page retired as a consequence of the system of rotation of membership of the Council recently introduced, and I wish to thank them for the time and thought they have so generously given to the work of the Council.

During the year under review no over-all expansion of the activities of the Department has been possible, but every effort has been made to maintain the standard of research work in the various fields with which the Department is concerned and to meet the many demands for services from other Government Departments and from industry.

Great advances are being made in science and its application in other countries, and if a desirable standard of living is to be maintained in this country we cannot afford to lag behind. It is seldom true that advances made elsewhere can be applied directly here, and the Department plays an important part, not only in breaking new ground, but also in adapting the results of overseas research to suit local conditions.

It is important to the economy of the country that its manufacturing industries should be soundly based and technically efficient. The research associations, financed jointly by Government and industry, have made notable contributions to the technical progress and efficiency of the industries concerned, and I am pleased to report that, as a result of a recent review, the finances of these co-operative research organizations have been placed on a more satisfactory basis. In brief, it has been decided that the Government and industry will share the cost equally up to a maximum sum for each industry and that thereafter the Government will contribute £1 for every £2 contributed by industry in excess of that sum.

In order that good value may be obtained for expenditure on scientific research and services it is essential that the high quality of the scientific staff should be maintained. The Secretary, in his report, has drawn attention to the disparity between the salaries of senior scientific staff in this country and those in other countries of the Commonwealth. There is already evidence that some of our best scientific officers are being attracted overseas and that it will become increasingly difficult to recruit staff of the calibre needed to supply the future scientific leaders in the Department. These are matters of fundamental importance and are causing me much concern at the present time.

I wish to thank the staff of the Department for the services they have rendered during the past year and to express my appreciation of the contribution they have made to the general welfare of the country.

R. M. ALGIE,

Minister in Charge of the Department of
Scientific and Industrial Research.

SECRETARY'S REPORT

The Hon. R. M. ALGIE, Minister in Charge of the Department of Scientific and Industrial Research.

I HAVE the honour to submit herewith the annual report of the Department for the year ending 31 March 1955.

The Council of Scientific and Industrial Research held five meetings during the year and maintained a constant review of projects and finances administered by the Department. The November meeting was held in Palmerston North and Council inspected the work in progress at Grasslands Division and grant-aided research being undertaken at Massey Agricultural College.

The term of appointment of Council expired at 31 December 1954. Sir Theodore Rigg, who had been a member of Council since its inception in 1926 and Chairman since 1943, did not seek reappointment—thus severing his long association with Council. The introduction of a system of rotation of Council membership whereby the two members with longest service retire each year also led to the retirement of Mr J. Ranstead and Dr R. O. Page. I should like to place on record the Department's indebtedness to these three members for their long service in promoting and guiding the work of Council.

Council's membership as at 31 March 1955 was—

D. F. Sandys Wunsch, M.A. (Oxon.), B.Sc. (McGill), M.I.Chem.E., F.N.Z.I.C., A.I.M.M. (Chairman).

J. C. Andrews, M.Sc., Ph.D., F.R.I.C., F.N.Z.I.C., A.M.I.Chem.E. (Deputy Chairman).

E. J. Fawcett, C.B.E., M.A. (Cantab.).

E. R. McKillop, C.M.G., O.B.E., M.I.C.E.

H. D. Purves, M.Sc., M.B., Ch.B.

G. A. Currie, B.Sc., B.Sc.Agr., D.Sc., LL.D. (Aberd.) D.Litt. (W.A.).

D. M. Rae, M.A., Dip.Ed., F.R.Hist.S., M.P.

E. Marsden, C.M.G., C.B.E., M.C., D.Sc. (Manc.), Hon.D.Sc. (Oxon), M.I.E.E., F.R.S., F.R.S.N.Z.

M. M. Burns, M.Sc. (N.Z.), Ph.D. (Aberd.), F.N.Z.I.C.

W. M. Hamilton, M.Agr.Sc., D.Sc., N.D.H. (N.Z.). (Secretary).

The Department is greatly indebted to the Council and its specialist advisory committees for valuable criticism and guidance in many matters associated with the promotion and organization of scientific research and the work of the Department.

EXPENDITURE, 1954-55

Expenditure in the various branches of the Department in 1954-55 is shown in the table below. Two salary increases which took effect during the year involved additional payments estimated at £19,000. The greater part of this was absorbed by provision made for vacancies that could not be filled, so that expenditure exceeded estimates by only £5,000.

Table of Expenditure, 1954-55

Branch	Staff, 31 March 1955	Salaries	Other Expenditure	Total Expenditure, 1954-55	Voted, 1954-55
Head Office	76	£ 59,477	£ 11,402	£ 70,879	£ 72,080
Animal Ecology Section ..	7	5,463	2,021	7,484	7,600
Applied Mathematics Laboratory	15	9,795	1,345	11,140	13,000
Auckland Industrial Development					
Laboratories	30	23,467	7,953	31,420	30,330
Botany Division	20	16,230	7,077	23,307	23,000
Crop Research Division ..	44	28,154	19,697	47,851	45,350
Dominion Laboratory ..	143	101,462	48,963	150,425	157,210
Dominion Physical Laboratory ..	178	129,368	66,502	195,870	193,240
Entomological Research Station	10	8,025	6,568	14,593	14,510
Fats Research Laboratory ..	18	12,888	3,939	16,827	16,960
Fruit Research Station ..	23	17,674	18,393	36,067	34,140
Geological Survey	54	42,892	17,152	60,044	59,890
Geophysics Division	66	46,188	37,247	83,435	79,540
Grasslands Division	80	55,855	28,755	84,610	79,780
Hop Research Station	3	2,495	5,692	8,187	7,460
Information Bureau	20	15,473	19,926	35,399	36,730
Plant Diseases Division ..	54	39,622	18,506	58,128	59,050
Scientific Liaison Services ..	3	7,071	4,515	11,586	11,810
Soil Bureau	69	49,013	18,527	67,540	65,920
Tobacco Research Station ..	5	3,579	5,689	9,268	8,940
Wheat Research Institute ..	9	7,377	1,875	9,252	9,490
Research General	..	..	126	126	371
Scholarships	..	..	6,496	6,496	7,610
Miscellaneous	..	..	390	390	200
Grants—					
Universities and agricultural colleges	..	..	29,335	109,054	109,789
Incorporated Research Associations	..	..	42,781		
Statutory and miscellaneous ..	..	..	36,938		
Less recoveries	927	681,568	467,810	1,149,378	1,144,000
	..	..	..	64,646	60,000
Net expenditure	..	..	..	1,084,732	1,084,000

The actual staff employed on 31 March 1954 was 937, but provision was made in the estimates for 48 persons to fill vacancies existing at that date, giving a total of 985. By 31 March 1955 the Department had sustained a net loss of 10, making the actual staff at that date 927, as shown above.

The staff at 31 March 1955 comprised professional 372 (374); clerical 157 (162); technical 342 (347); others 56 (54): total 927 (937); figures for previous year in brackets.

In order to place the above table in perspective, figures for the last six years, and estimates for 1955-56, are shown in summary below, together with a column showing the expenditure of D.S.I.R. as a percentage of the national income (gross national product).

Year	Total Staff at 1 April	Gross Expenditure	Cost Per Staff Member	Gross National Product	D.S.I.R. Expenditure as Percentage of National Product
1949-50 ..	929	£(000) 959	£ 1,032	£(m.) 552.4	0.174
1950-51 ..	981	962	981	696.2	0.138
1951-52 ..	997	1,096	1,099	720.3	0.152
1952-53 ..	1,013	1,010	997	753.4	0.134
1953-54 ..	931	1,090	1,171	827.1	0.132
1954-55 ..	936	1,149	1,224	*	*
1955-56 ..	928	1,210†	1,304	*	*

* Figures not available.

† Estimates.

In 1949-50 salaries absorbed 48·9 per cent of the departmental vote; in 1954-55 they absorbed 59·3 per cent. Expenditure other than salaries showed a corresponding decrease from 51·1 per cent in 1949-50 to 40·7 per cent last year. Expenditure other than salaries by branches of the Department shows a decrease from £396,214 in 1949-50 to £334,401 in 1954-55. It may be relevant to note that during this period the retail price index has risen nearly 40 per cent. During the same period grants to other organizations increased from £78,865 to £109,054 and accounted for 9·5 per cent of the Department's expenditure in 1954-55.

SALARIES OF SCIENTISTS

In last year's report I wrote, "At the present time we are trading dangerously on the loyalty to the Department of key scientific personnel". During the past year the salaries of senior directors of branches have been increased from £1,440 per annum to £1,600 per annum. No other country in the Commonwealth pays so little for scientific posts of comparable responsibility.

This discrepancy in salary rates is high-lighted by comparison with our nearest neighbour, Australia. The table below makes a comparison between scientific salaries in the Commonwealth Scientific and Industrial Research Organization in Australia and those in force in New Zealand at 31 March 1955:

C.S.I.R.O., Australia		D.S.I.R., New Zealand	
Designation	Salary £(A.)	Designation	Salary £(N.Z.)
Chief of Division	3,200-4,200	Director of Division	1,500-1,600
Chief Research Officer	3,200-3,400	Assistant directors	1,500
Senior Principal Research Officer	2,678-3,000	Section leaders	1,440-1,500
Principal Research Officer	2,228-2,588	Directors of small units	1,270-1,390
Senior Research Officer	1,814-2,078	Senior research officers	1,170-1,390
Research Officer	1,184-1,730	Research officers	664-1,110

Approximately 93 per cent of professional staff in D.S.I.R. are classified as either research officers or senior research officers, while only 74 per cent are in these grades in C.S.I.R.O. Expressed in New Zealand currency Australian salaries at recruitment are 50 per cent above New Zealand rates for comparable qualifications and this discrepancy increases with increasing seniority, chiefs of divisions receiving approximately twice the salaries of directors of divisions in D.S.I.R. in New Zealand.

The full impact of the increased salary scales now operating in Australia has not yet been felt, but already one senior officer of the Department has accepted a position at twice his present salary and at least four others are known to be considering similar attractive offers, while a number of potential recruits have gone to Australia instead of accepting positions in New Zealand.

The danger of this situation is that it can lead to an insidious lowering of standards which, by its very nature, is not easy to detect. The University of New Zealand has produced in recent years an average of twenty graduates a year with first-class honours in science. Most of these

secure scholarships to enable them to continue their studies overseas. Failing personal reasons, there appears little inducement for them to return to the low salaries and relative scientific isolation of New Zealand. While it is probably true that the rare, outstanding graduate should rightly fill a larger role overseas, a fair share of our good graduates must be retained in New Zealand if future national development is not to be jeopardized.

Sir Ben Lockspeiser, Secretary of the D.S.I.R. in the United Kingdom, giving evidence before the Royal Commission on the Civil Service (1954) said, "Perhaps the most vital factor in determining the effectiveness of a scientific establishment [cf. branch or laboratory in New Zealand] is the calibre of its head. An inspiring leader can produce results of high quality and quantity from a staff which, under a less gifted head, might give indifferent performance. For this reason the primary basis for assessing the status of a head of an establishment, or of a branch of work which stands largely by itself, should be his relative independence of command and scientific authority and the size of his command should be a secondary consideration".

The efficiency of research in New Zealand is dependent on the calibre of the staff we can recruit and retain. Soils and pastures and the produce derived from them are just as important to New Zealand as to Australia, the problems they present just as complex. New Zealand needs, and is fortunate in having, officers just as competent for research in these fields. I suggest, however, that we can hardly expect to retain men of this calibre or recruit successors of equal calibre on our present scale of scientific salaries.

ACCOMMODATION

The new building for the Grasslands Division was opened by His Excellency the Governor-General, Sir Willoughby Norrie, on 3 December 1954. This replaced the building destroyed by fire in 1940, and provided much needed relief from the cramped temporary accommodation that has been occupied during the intervening years.

Careful consideration has been given during the year to the building needs of the Department. A list of priorities has been prepared and is at present being considered by the Council of Scientific and Industrial Research.

The need for a rebuilding programme is illustrated by the fact that when the D.S.I.R. was established in 1926 the Dominion Laboratory, the Geological Survey, the Magnetic Survey, and the Seismological Observatory were brought under its administration. All these units are still housed in the buildings they were occupying in 1926, though there have been additions and modifications to some of the premises. None of them, however, has been substantially rehoused during this period.

With the formation of the Plant Research Bureau in 1936 and the dispersal of units from Palmerston North, new buildings were erected for the Plant Diseases Division at Mount Albert, Crop Research Division at Lincoln, and the Grasslands Division at Palmerston North. The Grasslands building was destroyed by fire in 1940 and a replacement block has just been completed. The Dominion Physical Laboratory, which was largely a wartime growth, was housed in new wooden buildings at Gracefield.

The three agricultural units and the construction of the Dominion Physical Laboratory represent the only major buildings undertaken to house D.S.I.R. units in the twenty-nine years since the Department was established. As well as the new accommodation thus provided, substantial and in many ways uneconomic amounts have been spent on modifying existing buildings to meet branch requirements. Such modifications are nearly always expensive, and the results often leave much to be desired.

Some units, such as Geological Survey, Soil Bureau, Seismological Observatory, and Dominion Laboratory, are at present very inadequately housed. Approximately 90,000 square feet of new space is required to accommodate those branches of the Department, without making any provision for future expansion.

RESEARCH ASSOCIATIONS

In his report to the Government in 1926 on the organization of research in New Zealand, Sir Frank Heath recommended the establishment of co-operative "research associations" similar to those in the United Kingdom. A research association is an industrial research organization that undertakes research and other scientific work of general importance to the industry which it serves. Each is a joint effort by Government and industry with the major share of responsibility for control and programme of work placed upon industry.

The first to be formed was the Dairy Research Institute in 1927, followed by the Wheat Research Institute in 1928, the Leather Research Association in 1928, and the Wool Manufacturers' Research Association in 1937. These were units of the Department, which administered them under the guidance of advisory committees comprising representatives of Government and industry. Half the cost of the work was paid for by industry.

The research associations dealing with the dairy, leather, and wool industries have since "incorporated" as industrial research associations, and three additional incorporated associations have been established. The existing associations and the years in which they were incorporated are—

- 1945 New Zealand Woollen Mills' Research Association (Inc.)
- 1946 The New Zealand Pottery and Ceramics Research Association (Inc.)
- 1947 The Dairy Research Institute (N.Z.)
- 1947 Research Institute of Launderers, Drycleaners, and Dyers of New Zealand (Inc.)
- 1947 New Zealand Fertiliser Manufacturers' Research Association (Inc.)
- 1949 The New Zealand Leather and Shoe Research Association (Inc.)

The Wheat Research Institute remains a branch of the Department, functioning through the Wheat Research Committee and recovering half of its expenditure from flour millers and bakers through levies on flour. The Hop Research Station and the Tobacco Research Station operate under similar arrangements with industry.

Each of the incorporated research associations is an independent self-governing organization. Finance is provided by the industry whose contributions are matched by Government. The associations have their own laboratories and employ their own staff. The control of each association is vested in a management committee comprising representatives elected by the industry concerned and at least two Government nominees. Well-balanced research programmes are achieved by virtue of the fact that the industrial representatives are closely acquainted with the problems of their industries, while the Government representatives provide the necessary scientific outlook and are able to co-ordinate the work with the activities of other research organizations.

The associations keep their members informed on relevant research in other countries by affiliation with similar research associations overseas. By interpreting and modifying results to suit New Zealand conditions the benefits of world-wide research are made available to large and small firms in this country.

The research association is an economical and effective form of industrial research organization, and one particularly suited to New Zealand where manufacturing industry comprises many small units. Each association builds up a team of first-class scientists with an intimate knowledge of their industry and whose whole energies are directed to the technical advancement of that industry. In this way the services of highly qualified and experienced scientists are provided for an entire industry with the utmost economy in scarce manpower and in facilities. The associations are a means by which industry can co-operate to secure the aid of science, essential for the development of industry to a high standard of technical efficiency.

On the practical side, the associations have proved their worth by carrying out research on problems that are peculiar to New Zealand conditions and materials, by keeping their industries informed of significant scientific developments, and by assisting in the application of scientific techniques and results of research.

The success of the research associations may be gauged from their growth and the increasing support by industrialists. The five associations, other than the Dairy Research Institute (in which the industry as a whole is represented by the New Zealand Dairy Board), are supported by individual member firms who now number 326 as compared with 159 five years ago. In the same period the staffs employed by all six associations have increased from 47 to 71.

The importance of research associations in the national interest was given full consideration during the year when the basis for the Government contributions was reviewed and modified. Previously the Government made grants to the associations on a pound-for-pound basis up to a limit specified in each particular case. The limits of pound-for-pound have been raised and Government has agreed that funds subscribed by industry in excess of the new limits will earn a further grant at the rate of £1 for every £2 from industry. The new terms will assist the existing research associations to develop further by encouraging industry to increase its contributions and so qualify for additional Government grant. At the same time general principles were formulated for the financing of any new research associations, and it is hoped that more industries will be encouraged to form such organizations.

It may be mentioned that another form of co-operative research is available for industries that are too small to justify the formation of research associations. In such cases research for a particular industry, or group of firms, may be undertaken by one of the Department's laboratories. The programme of work is arranged by an advisory committee representing industry and Government and the cost is shared equally between industry and the Government. Under this scheme research on bacon-curing problems is being undertaken by the Dominion Laboratory in collaboration with firms in the industry.

RESEARCH

In the following section a brief review of work completed during the year is given. Items that appear to be of general interest have been selected, and are outlined in non-technical terms with sufficient background information, where necessary, to explain the significance of the work. No attempt has been made to cover all work completed or necessarily to mention every branch of the Department.

AGRICULTURAL RESEARCH

Pasture Establishment on Pumice Soils.—Since 1947 land development on the pumice soils of the central North Island has progressed rapidly. Grassing has proceeded quickly from the margins of the pumice, where farms had been previously established, towards the centre of the region, where the pumice is deeper and coarser and had never been farmed before. The programme has called for the establishment of permanent pasture directly on the virgin land after it was cleared and cultivated. The red clover established readily, but white and subterranean clover were often slow to develop and grasses were weak because of nitrogen starvation. Though the initial strike was good, the majority of the white clover plants were weak and many died within a few weeks unless conditions were very favourable. Ultimate development of a good pasture was thus often delayed.

The Soil Bureau was engaged on surveys of the coarser pumice soils, Grasslands Division was studying the effects of accurate placement of seed and fertilizer in close proximity to each other, and Plant Diseases Division was investigating the various strains of nodule bacteria in clovers and their efficiency as nitrogen-fixers. Since all these units were working towards one end—the rapid establishment of pasture—a committee of the research workers involved, including officers of the Department of Agriculture, was formed so that periodically progress could be reported, knowledge pooled, and plans discussed. Two experimental areas were made available by the Department of Lands and Survey and experimental work was concentrated on these.

From a wide range of glasshouse and field trials the results at Plant Diseases Division have shown that:

- (a) Good strains of nodule organisms behave similarly in different soils and locations.
- (b) Inoculation of seed has improved establishment of red, white, and subterranean clover on virgin country. The improvement is marked when efficient strains are used, and this has been confirmed by large field trials and farmer sowings.
- (c) One strain has been selected which is effective for the three clovers over a wide range of conditions.

The number of vigorous seedlings (calculated as a percentage of total emerged seedlings at eight weeks from sowing) ranged from 22 per cent for the non-inoculated controls to over 90 per cent for the most effective inoculation procedure.

Nodulation efficiency is intimately related to the number of bacteria applied to the seed mixture. Using various inoculation techniques it was found that the addition of 2,500 bacteria per clover seed resulted in 50 per cent nodulation at eight weeks, 40,000 per seed in 80 per cent, and 500,000 per seed in 90 per cent. Taking 80 per cent nodulation as a reasonable target it is obvious that fairly high rates of inoculum are necessary.

The inoculation of pasture seeds mixtures, in which clovers amount to only about one-quarter of the total, poses problems not encountered in inoculation of lucerne. Ideally, the inoculum would be added when the mixture is made up by the supplying firm, and this would be satisfactory where the seed is sown immediately after mixing. Where large areas are being sown and where mixed seeds must be stored for periods of some weeks, such a solution is impossible owing to the rapid decrease in numbers of bacteria under those conditions.

Preparation and distribution of efficient strains of clover inoculum is now being done by private enterprise, and a certification scheme is planned by which the Department will check the effectiveness of the strain being distributed.

The acute nitrogen deficiency in pumice soil pastures, which can be overcome by vigorous clover growth, is accompanied by an equally acute phosphate deficiency, and the necessity for high rates of phosphate application during establishment has long been recognized. Trials conducted by the Grasslands Division have shown that phosphate is more efficiently utilized by placement; for the first six months, 1 cwt. superphosphate placed with the seed gave as good results as 3 cwt. broadcast. The roller drill, which concentrates inoculated seed and fertilizer in bands at 3 in. centres, has proved most satisfactory for this purpose, and has the added advantage of ensuring that the seed is covered to the optimum depth for good germination and nodulation.

By combining inoculation with fertilizer placement and positioning of the seed below the soil surface better emergence of both grasses and clovers can be achieved. At twelve months from sowing a seeding rate of 16 lb. per acre with the improvements listed above gave practically as good a ground cover as 32 lb. per acre, while even 8 lb. per acre was better than the standard method of broadcast sowing, also at 32 lb. per acre. Substantiation of this result in large-scale trials would lead to considerable savings in seed, but it must be recognized that some changes in the proportion of species may be necessary if greatly reduced seed rates are to give the best results. It seems likely that, when techniques have been perfected, inoculation and placement will ensure that first-class pastures are established on the coarse pumice soils.

Lucerne on Pumice Soils.—The failure of lucerne to establish in pumice soils is largely due to lack of fertility to assist plants in early stages of growth. Trials in raw pumice and in the same pumice when fertility is improved by addition of green manure show that lucerne readily establishes in the latter.

Nodulation of lucerne in raw pumice is not as high as in better soils. The reason is not known, though nodulation is appreciably increased by liming, placement of seed, and fertilizer and green manuring. Efficiency of nodule bacteria is not a factor. The results suggest that lucerne on pumice soil should be established after pasture or crop and not at initial cultivation.

During the year cultures sufficient to treat 525,955 lb. of lucerne seed have been supplied to 3,507 customers.

Earthworms in New Zealand Soils.—Field observations indicate that the activities of earthworms, both at present and in the past, have greatly influenced the processes of soil formation. As little information was available on New Zealand earthworms and their activities, a survey of New Zealand earthworms was undertaken by the Soil Bureau. The survey has shown that there are, in New Zealand and its surrounding islands, 187 species of earthworms: 178 may be regarded as native (87 of these are new to science), and 9 are introduced species of European origin.

The native species played an important part in the formation and development of our soils before the land was cleared and used for agriculture. They fall into three groups, (*a*) small worms that live in the accumulated leaf mould on the soil surface, (*b*) larger worms that live in the topsoil, and (*c*) species, frequently of great size, that live in the subsoil. Some worms cast at the surface, and some under the surface in abandoned burrows and natural spaces between soil particles. All three groups are dependent for their food, directly or indirectly, on the supply of dead plant material in the leaf mould, and by their feeding and casting activities have combined to maintain a high rate of incorporation of organic matter with the mineral soil material, while their burrowing assists in drainage and aeration, thus influencing the fertility and processes of formation of our soils. Where native worm populations have been high, and especially where very large subsoil species have been present, their effects have been a major factor in soil formation (e.g., parts of Canterbury Plains and the Wairarapa). There is evidence that the activities of native worms in forest soils are an important factor in the maintenance of suitable conditions for the establishment and growth of seedlings of native trees.

When native vegetation is removed and replaced by farmlands, the pattern of the earthworm fauna is changed. The native species, deprived of their natural source of food, rapidly decline and disappear, except for a few subsoil species. Their place is taken by three or four of the introduced European species, one or two of which are the so-called "casting worms". These species are active only in the top few inches of the soil. Once they are established in an area they increase in numbers very rapidly, and populations frequently reach 1,000,000 or more per acre. Under grassland conditions their spread is rapid, and in most localities there is little point in introducing them where they are absent, and no point at all in introducing them where they are already present, since natural migration will assure their presence and availability of food will control the limit of their population density.

It has been found that the ancestors of the native earthworms entered New Zealand in at least two distinct migrations, one of which—a very long time ago—populated the whole of the country and its surrounding islands; the second migration is more recent and the spread of these species has been checked by volcanic activity in the central North Island, so that they are mainly confined to northern districts.

Survey of Soil Clays.—When a soil is shaken with water and allowed to stand the coarse sandy fractions quickly settle out leaving behind a muddy suspension, the soil clay, which has colloidal properties and is chemically very reactive. It has long been known that many soil properties and reactions to added fertilizer depend on the nature and amount of soil clays but it is only since the development of modern techniques—X-ray diffraction, thermal analysis, and electron micrography—that the nature of the finely divided minerals in the soil clay could be accurately determined.

Since 1949 a systematic study of soil clays based on the existing classification has been made, approximately 1,200 samples have been analysed and more than 20 different clay minerals have been recognized. The survey shows that the type of clay minerals found depends on the rainfall and temperature regime under which a soil has been formed as well as on the rock from which it is derived. Thus in the cool dry climate of Central Otago the clay consists of complex very finely divided crystalline minerals closely related to those in the parent rocks; in the warm, wet climate of North Auckland rocks weather more rapidly and break down more completely and the clays consist of simpler crystalline minerals only distantly related to the original parent rock.

Although the weathering of the original rock minerals in the soil is responsible for the main supply of mineral nutrients, the finely divided clay minerals that are formed can compete with the plant for certain essential elements. For example, in the yellow grey soils of Canterbury and parts of Hawke's Bay and the Wairarapa, and in the weakly weathered yellow-brown soils of upland areas, the clay mineral (vermiculite) is tending to take potassium out of the organic cycle into a more stable crystalline form of its own, while in the volcanic ash soils covering Taranaki, Waikato, and central North Island non-crystalline clay minerals of high surface area tend to absorb strongly the elements phosphorus and molybdenum. Where the soils are extremely altered by leaching with humic acids, as in the gumlands of North Auckland, the soil clay is largely finely divided quartz with a low adsorbent power, and added nutrients are quickly reflected in the composition of the plant.

Grass-grub and Oxycanus (Grass Caterpillar).—Reports have been made concerning the excellent results secured overseas with aldrin and dieldrin as insecticides against soil-inhabiting insects, and tests have been made by the Entomological Research Station comparing them against standard treatments of DDT and BHC.

Work against grass-grub and *Oxycanus* with DDT, technical BHC, Lindane, aldrin, and dieldrin showed that, where both pests occurred together, DDT and technical BHC applied at rates sufficient to provide 2 lb. of effective isomer per acre gave the best results. They were also sufficiently rapid in action to prevent pasture loss. Dieldrin gave good grub control at dosages of 1 and 2 lb. per acre and good *Oxycanus* control at 2 lb. per acre, but in both cases this action was too slow to prevent pasture loss. Aldrin gave good grass-grub control at dosages of 1 and 2 lb. per acre, but was almost ineffective against *Oxycanus*.

This last season there has been a very severe infestation of *Oxycanus* in Canterbury, and some farmers who did not use standard treatments lost more than one-third of their grazing pastures.

Control of Pests on Crucifers.—It has been estimated that losses caused by insect pests on field crucifer crops (rape, swedes, and turnips) in this country exceed £1,000,000 annually. Many commercial firms are interested in the field application of insecticides, and where previously it was not practicable for economic reasons to use these materials on a field scale, advances in application machinery and reduction in the price of materials have brought such a method well within the bounds of possibility. Last season the Entomological Research Station started a series of trials in Canterbury to try and assess the place insecticides might have in the reduction of insect injury to crops such as rape, and secured some interesting results. The common pests are the grey cabbage aphid, white butterfly, and diamond-back moth. Aphids were found to be the most difficult to kill. It was found:

- (a) Where cabbage aphid was present, $\frac{1}{2}$ lb. of gamma isomer BHC (Lindane grade) per acre gave practical control of all crucifer pests. The cost of the treatment was approximately £1 per acre.
- (b) Where diamond-back moth and white butterfly alone were present. DDT at 1 lb. per acre gave good results, as spray or dust.
- (c) Where crops were undersown with pasture mixtures, 2 lb. of 100 per cent p.p.i. DDT per acre as dust or in fertilizers gave good control of caterpillars, and also permitted the bulk of the dry material to fall on to the ground for future grass-grub control.
- (d) Lindane had no serious effects on ladybird and hover-fly, natural enemies of the cabbage aphid. The effect of DDT on these beneficial predators is not yet clear.

The question of insecticide residue and uptake by stock is important and is being investigated. This problem is closely related to the fact that rape and soft turnips are fed off relatively early, whereas hard turnips and swedes are used as winter feed. An important factor is that in Canterbury, during January and March, sprayed leaves are usually replaced by unsprayed leaves in from twelve to twenty days. Correct timing of insecticide applications is therefore likely to be important.

Application of Insecticide from the Air to Control Cereal Pests.—Army worms and cutworms, particularly the former, sometimes cause considerable losses in parts of New Zealand. Practical control was achieved by applying from the air DDT at $\frac{1}{2}$ lb. per acre (active isomer) as 3 to 5 gallons of emulsion or 1 lb. of DDT as a dry mix with up to 10 lb. of lime or superphosphate. DDT gave better results than BHC. If cereals were undersown with pasture, a dosage of 2 lb. of active isomer DDT per acre applied in lime or superphosphate from the air to kill caterpillars was also effective in preventing grass-grub damage to the pasture.

Manuka Blight.—Surveys made during the year showed that this is now established on manuka (*Leptospermum*) over approximately 11 per cent of the land area of the main islands of New Zealand, from Lilburne Valley in Southland to north of Kaitaia. Under North Island conditions the causative insect *Eriococcus orariensis* passes through a number of generations per year. The blight has not been found on plants other than the two species of manuka. During surveys particular attention has been paid to plants establishing in areas where manuka was dying. In all places examined, an adequate but not always desirable ground cover had appeared before death of the manuka occurred. No cases of accelerated erosion caused by death of manuka were observed.

Red Clover Pollinators.—Last year's work indicates that the provision of alternate food plants is a very important factor in building up populations of humble-bees for the fertilization of red clover. For example, tree lucerne (*Cytisus proliferus*) is an excellent source of food in winter and spring for the humble-bee *Bombus terrestris*, and where this tree is abundant populations of this species are able to build up to considerable levels by the time red clover is in flower. Unfortunately this source of food is over by the time the more useful *B. ruderatus* species is on the wing after hibernation, but the importance of tree lucerne to *B. terrestris* indicates that the availability of suitable food plants at the appropriate times for the more valuable humble-bee species would probably be a useful line for investigation.

Evidence has been collected that *B. hortorum*, a long-tongued species hitherto considered to be absent from New Zealand, may indeed be present. This point is being checked.

It would seem that distance from the coast has some influence on efficiency of the humble-bee species we have. In Canterbury the winter climate generally becomes colder as one goes inland. The colder the winter climate the longer is the hibernation period and the shorter the nesting period. Under these colder conditions the concentration of humble-bees appears to be greater at the time of flowering of the red clover. From this one would expect that greater yields of red clover seed would be secured in the inland areas, and this does in fact occur.

As far as honey-bees are concerned, it is clear that these insects can pollinate red clover and often assist materially in the production of seed yields. Their contribution, however, in any one year or district is very variable and depends on a number of factors, some of which are as yet unknown. Honey-bees have the merit that they can be moved from place to place and concentrated on an area at will. With more understanding of their behaviour in New Zealand conditions, their usefulness to the seed farmer may be greatly increased.

Use of Streptomycin in the Control of Blast of Stone Fruit.—Promising results have been obtained by the Plant Diseases Division with streptomycin in the control of blast of stone fruit. This is of particular interest because the usual therapeutants are ineffective against the disease.

Blast of stone fruit, which is widespread in New Zealand and has been present in the country for many years, is the major cause of death of young stone-fruit trees. Trees up to six years old are the most susceptible. In some areas, particularly Central Otago, considerable difficulty is experienced in establishing new plantings, over 90 per cent of the trees having been killed in one year in some orchards. Greatest losses occur amongst trees that are infected when they leave the nursery. All stone-fruit species are susceptible, and the causal organism also infects a wide range of other species causing economic losses in pear.

Under experimental conditions in glasshouse and field, streptomycin has given very promising control of the disease on peaches. In glasshouse trials it reduced infection from 91 per cent to 2 per cent, and in field trials from 70 per cent to 15 per cent. Not only did streptomycin produce a reduction in the number of lesions, but it also reduced the size of those lesions that did develop. In glasshouse trials it reduced lesion length to 1.3 cm. compared with 3.1 cm. on check trees and a comparable reduction occurred in field tests.

Streptomycin has also given promising results in control of blossom blast of pears which is caused by the same organism that causes blast of stone fruit. In trials under normal orchard conditions a low concentration of streptomycin reduced infection from 46 per cent to 25 per cent, whereas Bordeaux mixture had no effect.

One of the largest manufacturers of streptomycin has followed this work very closely and has released on the New Zealand market a streptomycin product for use in control of blast of stone fruit.

Control of Red Mite.—The control of red mite on fruit trees, vegetable crops, and ornamentals has always been a difficult problem. This has been partly due to the fact that summer oil, which is the best of the older therapeutants for the control of red mite, is incompatible with sulphurs and other fungicides, and cannot, therefore, be used in the usual spray programmes. On apples in particular the red mite problem has become more acute in recent years owing to build up of mite populations following the introduction of organic insecticides for control of codling moth and leaf rollers.

Work at the Plant Diseases Division has shown that excellent control of red mite can be secured by application of certain of the newer therapeutants which act as contact or residual acaricides. If applications are made early in the season when the presence of mites is first detected, the pest is controlled for the major part of the growing season, although in some districts further applications are necessary in late summer.

Cool Storage of Fruit.—Since the inception of cool storage for apples and pears, storage operators have suffered serious loss from a range of disorders that make fruit unsaleable. During the past thirty years departmental officers have investigated a number of these problems, searching for ways of reducing loss. Considerable success was achieved, but many of the results are not available to storage operators as they are scattered through various journals. To ensure that this information is available to every one interested in storing pip fruit, the Fruit Research Station has summarized all New Zealand results and published them as Bulletin No. 111. This includes descriptions of storage disorders and recommendations for minimizing loss in stored fruit.

Chemical Thinning of Apples.—Thinning of the apple crop is an essential operation in most fruit districts. Done by hand this is slow and expensive. Chemical thinning methods developed for local conditions by the Fruit Research Station are now in commercial use. A single spray of ANA (alpha naphthalene acetic acid) or DNC (dinitro ortho cresol) applied during the blossoming period removes about three-quarters of the surplus apples, making possible a large saving in labour.

Most apple trees carry a heavy crop one year and a light one in the following season, a phenomena known as biennial bearing. This disrupts marketing and annual income of the industry. If thinning can be carried out during blossoming in the year of heavy crop a good crop usually follows in the second year. Hand thinning is impractical at this early period, but chemical thinning has been shown to reduce biennial bearing under New Zealand conditions. In addition to making the annual yield per acre more regular, there are indications that the total crop over the two-year period is increased. Thus the new method has the three-fold advantage of saving labour, regulating annual crop, and increasing total production.

Grey Mould of Tomatoes.—Growing tomatoes under glass to supply early crops is now an important industry. Unfavourable climatic conditions in early spring prevent good fruit development on the earliest bunches. It was found that various hormones sprayed on to tomato flowers would cause fruit to develop under any weather conditions, and this practice was rapidly adopted by the industry. Unfortunately severe infections of grey mould (*Botrytis cinerea*) followed the use of hormones. A co-operative investigation by the Plant Diseases Division and the Fruit Research Station has shown that the inclusion of ferbam in hormone sprays will prevent attack by mould without affecting fruit development. Within two seasons this dual spray has become an accepted part of tomato-growing practice.

Stone-fruit Varieties.—Many varieties of stone fruit grown in New Zealand have been propagated from chance local seedlings. In the absence of published descriptions of such varieties it is difficult for nurserymen and others to identify them, and considerable confusion has followed. To remedy this position the Fruit Research Station has begun publication of detailed descriptions, the first appearing in the *Fruit Yearbook* for 1954.

Apple Stocks.—As apple varieties do not come true from seed, apple trees are raised by budding the desired variety on to a rooted apple cutting, the latter being known as the stock. The stock has a marked effect on subsequent growth and cropping and is therefore an important factor in the success of an orchard. The Northern Spy stock used in establishing the mature New Zealand orchards of today was not uniformly successful. During the past twenty years field tests of the most successful overseas stocks have been made by the Fruit Research Station. These showed that no one stock was sufficiently versatile to meet all requirements. A range of three stocks was selected (Malling XII and XVI, and improved Northern Spy) and these are now being supplied in quantity to fruitgrowers by their own co-operative association. These new stocks have solved the problem of replacing dead trees in existing orchards, and in new plantings on poor land the Malling stocks have given yields 50 per cent greater than those from Northern Spy. Further changes are likely in the future as attack from the root-rotting fungus (*Phytophthora cactorum*) is becoming increasingly serious and none of the present stocks is resistant to this disease.

Trace-element Deficiencies in Fruit Trees.—Plant Diseases Division discovered boron deficiency in apples in 1936, this being the first example of trace-element deficiency in fruit trees known to science. Since then deficiencies of boron, manganese, and zinc have been identified and corrected in a range of fruits. All New Zealand's major fruit districts are affected by one or more trace-element deficiencies. The Fruit Research Station has now rounded off its recent work on this subject by publishing a bulletin on boron, manganese, and zinc deficiencies in fruit trees. Symptoms are described and illustrated, methods of diagnosis outlined, and corrective treatment prescribed so that extension officers and fruit-growers can recognize and treat these disorders.

Plants of the Tussock Grasslands.—The Cytological Section of the Botany Division has established a stock of native plants in cultivation so that they are available for study at appropriate phases of seasonal growth. Such a collection has certainly never before been equalled in New Zealand. This has been achieved only by assiduous work for long hours by the two officers of the Section; but all other professional officers have assisted both by collections and by careful identifications. This collection, therefore, may be regarded as the first fruits of the better divisional team work that has been made possible by concentration of divisional sub-units into Canterbury and should assist in clarifying the nomenclature and relationships of the flora of the tussock grasslands. The correct naming of plant species is an essential prerequisite to any detailed study of the tussock grasslands and their problems.

This collection of native plants not usually cultivated incidentally formed the basis of the Division's exhibit at the very large flower show promoted by the Canterbury Horticultural Society in February. The central theme of the exhibit was, however, the dominant species of New Zealand tussock grasslands, centring around extremely well-grown flowering specimens of the native tussock and associated grasses. These had been grown in cultivation at the Botany Division's grounds at Bryndwr and showed these critical economic species in a state of perfection and vigour in which they are seldom seen on grazing grounds. The exhibit attracted much favourable attention and was awarded a Bronze Medal of the Horticultural Society.

Wheat.—During its trials over the last few years Line 393 has caused great interest among wheat growers in South Canterbury and North Otago. A non-shattering, high-yielding variety resistant to lodging and suitable for direct-heading is badly needed to replace Dreadnought in these areas. This new line of wheat is to be released under the name Arawa. Trials have indicated that the new variety is superior to Dreadnought in all important respects except milling where it is about equal. Dreadnought comprises only 3 to 5 per cent of the area of wheat in New Zealand, and it is expected that the new variety Arawa will prove popular because it is non-shattering and can be direct headed.

Potatoes.—Virus and blight are the two most important diseases affecting the potato in New Zealand. Disease surveys by the Crop Research and Plant Diseases Divisions have shown that most of our common varieties are infected with one or more virus diseases which reduce vigour and hence yield. No disease-free plants of these varieties have been found. The Potato Certification Scheme controls to a great extent viruses giving readily observable symptoms, such as leaf-roll and severe mosaic (Virus Y), but mild mosaic (Virus X) is difficult to eliminate. Virus-free seed of five varieties, imported from England some years ago, has been increased and further tested at C.R. Division. The late stages of increase are now being carried out by the Department of Agriculture. Of two varieties, Arran Chief and King Edward, sufficient seed should be available for a preliminary distribution in 1955-56. Virus-free Arran Banner, Epicure, and Craigs Snow White will also be available in time. A valuable stock of Aucklander Short Top free from Virus Y has been built up, and is being increased with all speed by the Department of Agriculture, all plants being check-tested by C.R. Division at frequent intervals.

Trials of advanced hybrids were laid down in six selected areas from Auckland to Dunedin. Of some 3,000 hybrid seedlings raised in 1948-49, 6 remained for trial in 1954-55, and of 1,500 raised in 1949-50, 33 were in one or more trials in 1954-55. Results varied considerably according to the district, but some 20 to 25 will be retained for a further year's trial, after which it may be possible to release one or more new varieties. The main advantages of the selections are high yield coupled with good shape and quality and in some cases with resistance to one or more strains of blight.

Vegetables.—Seed of a new table carrot has been released under the name "Sweet-Crop". It has been derived from the large cattle carrot, Holmes Improved, by selection for smaller size and better shape. It has found favour with home gardeners. Seed is also now ready for release of an early maturing strain of Best of All Savoy Cabbage, which is noteworthy for its high percentage of marketable heads and uniformity in time of maturity.

Hop Research.—The first aim of the Hop Research Station is to breed a new variety of hops that is attractive to growers and brewers, the one commercially grown at present being no longer acceptable to the majority of the growers because of its susceptibility to a fungus disease (*Phytophthora*) which is rapidly spreading through the hop gardens.

Before starting the breeding programme, however, it seemed essential to find the optimal conditions as regards the germination of the hop seed, which is known to be low under normal conditions. It was found that stratifying hop seeds in moist peat for six weeks, at temperatures between 35° and 40°F. gave quite satisfactory results, the germination percentages varying between 80 and 90 per cent. The breeding programme has been started now, and a first lot of 2,000 seedlings are developing in our nurseries.

The introduction in New Zealand of the hop-picking machine made it desirable to investigate the influence of the height of wiring of the hop garden and of the spacing of the hop hills on yield and quality of the crop. The first year's results of a 3½-acre experimental hop garden showed that growing hops on wirework higher than 14 ft. influenced neither yield nor alpha-resin content (brewing value), but spacing of the hop hills wider than 6 ft. by 6 ft. square consistently decreased the yield per acre.

Tobacco.—While the Nelson district enjoys a fairly reliable summer rainfall, dry spells of sufficient duration to adversely affect crops on the more open soil types do occur, and irrigation is becoming increasingly important. Little is known regarding the quantity of water to apply or the time to irrigate. A project was commenced this season to study the moisture conditions in tobacco soils and the effects of irrigation on the crop. Data on hand already indicate that many soils dry out much more rapidly after irrigation than was anticipated.

Weeds in the seedling beds, and to a lesser degree disease, are a problem to growers. While steam sterilization is an effective method of control, facilities are limited and an alternative method is necessary. The use of methyl bromide gas, as developed at the Station, has proved very satisfactory and, during the past season, 34 per cent of the growers used this method with good results. Application is at the rate of 1 lb. per 100 square feet of bed area.

Copper deficiency has been identified in the tobacco crop. It has been established on three distinct soil types. Symptoms are a failure to ripen accompanied by a chestnut brown breakdown of the leaf. Control consists of applying 40 lb. bluestone per acre prior to planting.

This season 80 per cent of the tobacco crop is of the Virginia Gold variety, a black root-rot resistant variety which was introduced by the Station four years ago.

Rabbit Population Studies.—Research is being undertaken into the ecology of the rabbit in order to obtain basic information about its biology and habits so that the problem of control can be re-evaluated on a scientific basis.

Studies of the reproduction of the rabbit have shown that the breeding season in Hawke's Bay lasts about twenty-four weeks, starting in the middle of June; during this time an adult female produces twenty-two young, although approximately one-fifth of the litters conceived are lost during gestation. Some rabbits can be found breeding at all times of the year but few, if any, of the young born outside the breeding season seem to survive for very long. Contrary to results of work on rabbits in England, young females born early in the season in New Zealand themselves start to breed the same year and the breeding season may be prolonged as a result. Observations on young animals showed that heavy mortality occurs from the time they leave the nest until the age of four months, by which age only 30 per cent are still alive. A large proportion of this age group suffers from severe infection with liver coccidiosis, which may be a contributory cause of the observed mortality. Despite this heavy juvenile mortality four-fifths of the population at the beginning of the breeding season are animals born the previous year.

The number of rabbit skins exported each year from New Zealand from 1900 to 1947 show marked fluctuations with peaks occurring at about eleven-year intervals; it has been suggested that these fluctuations reflect changes in the rabbit population. However, it might be expected that they would also be affected by the market price of skins and the amount of unemployment in the country. The figures have been analysed by the Applied Mathematics Laboratory which has shown that the fluctuations in rabbit exports are largely independent of these factors and presumably do reflect real changes in the rabbit population, indicating that for unknown causes the numbers of rabbits periodically increase greatly and then decrease again.

Ability to classify animals in age groups is an important prerequisite for many types of ecological research and for assessing results of control. Recent work on the sequence of bone fusion in the rabbit suggests that the degree of ossification of the vertebrae can be used to identify age classes beyond the present limit of nine and a half months. Work is now proceeding to determine the precise limits of these new age classes.

In a sample of rabbits collected from an area that had been previously poisoned with phosphorus it was found that certain animals showed a characteristic malformation of the bones due to their having received a sub-lethal dose of phosphorus. Although the effect is only to be seen in rabbits that are not full-grown at the time of poisoning, these findings may provide a method of assessing the efficiency of control operations based on the use of phosphorus.

APPLIED MATHEMATICS LABORATORY

Most of the work of this Laboratory is done to assist other organizations with their research projects. This assistance is sought particularly where the projects involve a number of factors difficult to measure separately and where unavoidable factors, such as variation in weather, affect the results of the experiment. In such cases it is necessary first to describe in mathematical terms what is actually happening in practice and then to use mathematical techniques to disentangle the various factors and assess their relative importance.

An example of such a problem is the determination of mortality rate of rabbits under natural conditions at different ages. The experiment, which involved the capture, marking, and release of a large number of rabbits, was conducted by the Animal Ecology Section. This Laboratory was able to assist by devising a mathematical model that described the situation and enabled the mortality at different ages to be assessed from the raw data of the experiment that by itself could give only a confused picture from which it was impossible to draw specific conclusions. This analysis showed that the mortality decreased sharply after the first three or four months. This confirmed other work done on different rabbits and by entirely different methods which suggested that the infection and death rates caused by certain parasites was an important source of death among rabbits during the first three months but caused relatively few deaths after this period. Such confirmation could not have been provided by raw unanalysed data.

The use of mathematical techniques in this way enables us to obtain quantitative ideas of the importance of the various influences that affect one of New Zealand's major pests.

BUILDING AND BRIDGE FOUNDATIONS

A bulletin entitled *Records of Site Exploration* is in preparation by the Soil Mechanics Laboratory of the Soil Bureau. The main activity of this Laboratory over the last ten years has been service work as consultants to engineers both State and private. Investigations have ranged from simple physical examination of submitted samples to comprehensive site investigations and laboratory testing for structural foundations and earthworks. These investigations, being limited to clients' requirements with little opportunity to follow up details of design and performance of structures as affected by soil conditions, have rarely provided material for scientific publication, but nevertheless a considerable volume of information on site conditions at specific points throughout the country has been accumulated.

This preliminary work has proved the value of soil testing in enabling structures to be designed to fit particular sites. It has enabled over-design and needless over-expenditure on foundations to be avoided where the site was satisfactory for normal design procedure. It has prevented under-design and subsequent costly remedial measures by indicating the modifications to normal design required by underground instability of the site. In a number of instances it has drawn attention to alternative sites close by, where the structures could be erected without the costly preparatory work required on the site proposed. These examples have proved beyond doubt that the comparatively small expenditure involved in preliminary site exploration work is today a necessary insurance against possible failure of the structure and costly remedial measures.

Future work within the Soil Bureau will be directed to such objectives as improving the techniques to meet the special conditions arising in New Zealand and exploring methods of shortening the time necessary to carry out the tests. Routine methods of testing can now well be carried out by the engineering bodies concerned.

The disaster resulting from the destruction of the Tangiwai railway bridge by a lahar on the 24 December 1953 aroused widespread interest in the problems of foundation engineering, a subject which is much less highly developed than that of structural engineering. Investigations are being carried out by the Geophysics Division on a proposed method of testing foundations by measuring their natural frequency of vibration. Promising results have been obtained from tests on foundations of both caisson and reinforced-concrete pile types, and it is hoped to develop a technique for finding whether a pile has suffered fracture in the process of driving.

MEDICAL INSTRUMENTATION

The programme of medical instrumentation at the Auckland Industrial Development Laboratories has been extended during the past year.

Throughout the world there has been a growing realization in the medical profession that they can benefit from close collaboration with the physicist and engineer in the use of the latest techniques of measurement. This has been demonstrated in Auckland and elsewhere in New Zealand by the introduction of modern techniques of measurement into both clinical medicine and medical research. Being in the development stage in most countries the equipment is not usually available commercially.

A series of experiments has been continued during the year to investigate methods of inducing hypothermia, or reduced body temperature. At reduced temperatures the body's oxygen requirement is considerably reduced and the circulation may be interrupted for periods sufficient to allow surgical repair to be attempted within the heart and on the great arteries. Cooling has been by a special refrigerated blanket or by direct immersion in ice water.

The subject, is, of course, anaesthetized, and equipment has been developed for simultaneously recording the rectal temperature, the electrocardiograph, pulse rate, blood pressure, and in the earlier experiments oxygen consumption.

In patients suffering from a circulatory deficiency of any kind a measurement of the oxygen saturation of arterial blood may be important. This is particularly so when the patient is anaesthetized during surgery. The oximeter operates from a combination of photo cells, filters, and a light source which is clamped on an ear. The colour of the blood flowing in the ear is very carefully recorded as a measure of arterial oxygen. This instrument has been continually improved and has been used on a number of difficult surgical cases.

For the post-graduate school of obstetrics and gynaecology at the National Women's Hospital a number of instruments have been developed. One records continuously the dilatation of the cervix during the earlier stages of labour. Another records continuously the rate of drip of intravenous pitocin, a drug used in the artificial induction of labour. At this institution also, a two-channel pressure recording equipment has been installed for the recording of uterine activity during induced labour. All these instruments form part of a programme of research being carried out by Professor Carey.

For clinical use an interesting automatic respirator for premature infants is being developed. If the baby has spontaneous but inadequate breathing, the machine will pick up each inspiration and reinforce it. If it has no spontaneous breathing the machine will automatically provide a continual artificial respiration. This machine is the first of its kind in New Zealand.

Work is proceeding on the development of a method of continuously recording the foetal pulse rate during labour as a means of warning of impending foetal distress.

Allied to the medical instrumentation some work has been done on instrumentation in the field of animal physiology.

Equipment is being developed to record internal pressures and other relevant data in cows suffering from bloat to assist the animal physiologist in his investigation of the fundamental causes of bloat. Small pressure-sensitive devices have been made that can be located in various parts of the rumen or first stomach, and the actual pressure changes at these points are recorded electrically. These methods make available much more accurate data for the research worker than has previously been available.

PALEONTOLOGY

Ever since the birth of geology as a science the fossil remains of organisms have been used for correlating rocks of the same age in different areas and for dating them in terms of the geological time scale. The recent development of radioactive methods of dating rocks has in no way detracted from the importance of fossils, since the radio-carbon method can be used to date events of only the last 45,000 years, and the uranium-lead methods are expensive and limited in application.

The paleontological correlation of rocks depends on recognizing differences between fossils of successive strata, differences due to evolution and the migration and extinction of plants and animals in the course of geological time. Increased precision in paleontological correlation, such as is required for detailed structural geology, depends on intensive study of whole groups of animals and plants whose remains are found in fossils, so that paleontology becomes increasingly complex, because it involves fusion of two specialist disciplines—biology and geology.

Systematic study of New Zealand fossils began in 1859 when the Austrian geologist Hochstetter took specimens back to Europe, and was continued by the New Zealand Geological Survey (founded 1865) and by geologists in universities and museums. Early work was concentrated on larger fossils (sea-shells in particular) which are still most useful for correlating some parts of the geological column. In 1932 Taranaki Oil Fields Ltd. engaged the late Dr H. J. Finlay to study fossil Foraminifera, minute shelled protozoans which are abundant in Cretaceous and Tertiary sediments and are the most important fossils for deciphering the structure of oilfields in America, the Middle East, and the East Indies. Micropaleontology, the study of such minute fossils, is now an essential part of oil exploration. From 1937 until his death in 1951 Finlay continued his work at the Geological Survey, and collaborated with Dr J. Marwick to produce a twenty-three division classification of New Zealand Tertiary rocks as detailed as anywhere in the world.

This classification has already proved invaluable in the exploration of coalfields since mapping of Tertiary structure using fossils enable prediction of the position and attitude of hidden coal measures at depth. This year, study of the fossil shells known as *Inoceramus* has for the first time allowed detailed zoning of our Cretaceous formations which are source beds of oil seepages on the East Coast.

Recent research on fossils has thus provided a much more precise stratigraphic tool than was available during the nineteen twenties and thirties when oil exploration was last prosecuted in New Zealand on a large scale.

Efficient use of fossils in New Zealand stratigraphy depends on continued research on the classification of many thousands of specimens (Foraminifera, corals, sea-eggs, brachiopods, polyzoans, molluscs, crustacea, plants, etc.) in the Geological Survey collections, which are at present housed in an old wooden building subject to serious risk by loss by fire. Geological Survey paleontologists have generally limited their research to the commonest fossils—Foraminifera, brachiopods, molluscs, and plants—but other groups have been submitted for report to experts in universities and museums.

Paleontology is today an essential tool for the correlation and dating of geological strata and the interpretation of the geological record. It has a vital role to play in the search for oil in New Zealand, which is shortly to be renewed, and such assistance is likely to impose a severe strain on the Geological Survey's resources.

MARAMARUA COALFIELD

Following a request by the State Hydro-electric Department to the Mines Department in 1951 to ascertain whether sufficient reserves of coal were available in the Waikato for establishing a steam-generating plant of 100,000 kW. capacity, the Geological Survey, in co-operation with the Mines Department, investigated the resources of the Maramarua coalfield. The requirements of such a plant over a life of sixty years are 21 million tons of coal. The area has been extensively drilled and estimated to contain 33.5 million tons of indicated coal and 20.8 million tons of inferred coal, ample reserves for such a plant.

CRETACEOUS STRATIGRAPHY AND THE TAITAI OVERTHRUST

Oil and gas seepages have long been known at Ruatoria, Totangi, and Waitangi, and at several other places near the east coast of the North Island. Several attempts have been made to find worth-while reservoirs, but the work has been handicapped by a lack of understanding of the way in which the rocks have been folded and deformed. A knowledge of the structure depends on first knowing the stratigraphic order in which the rocks were deposited, and this in turn depends on a knowledge of fossils; for fossils have proved to be the most reliable way of tracing a particular stratum over a wide region. Some of the largest gas and oil seepages are those at Ruatoria, and this area and the neighbouring Tapuwaeroa Valley have provided the clue to the regional structure and stratigraphy. During the first detailed examination by the Geological Survey in 1928 it was thought that the hard sandstone of Mount Taitai and adjoining peaks had been thrust from the west for many miles over softer and younger siltstones, and that the Taitai sandstone and older rocks were devoid of oil. A study of the sediments

and of the rare fossils that they contain now indicates that this view was wrong and that the siltstone below the Taitai sandstone is lower Cretaceous, slightly older than the Taitai sandstone and very much older than the upper Cretaceous siltstone with which it was confused.

It now seems certain that some oil and gas are coming from lower Cretaceous sediments. It thus becomes important to know more about these sediments, which had previously been somewhat neglected, and to find how they change in degree of compaction from place to place along the east coast. At present it seems likely that they were so deeply buried at the head of Tapuwaeroa Valley that the oil was squeezed out or changed to pitch, but that they were less deeply buried along the region of the seepages. The lower Cretaceous rocks are the oldest exposed along the coastal belt of the east coast and are mostly covered by younger sediments so that their degree of compaction can only be directly determined at a few places. They appear to have been most deeply buried beneath Ruakumara sediments, and these rocks are now being studied in order to find out how they change in thickness from place to place.

GEOHERMAL INVESTIGATIONS

General investigations have been continued by the Dominion Physical Laboratory to obtain long term data of thermal activities. These include field studies of geysers in the Wairakei and Orakei areas, the initiation of a precision survey of levels at Wairakei to detect large scale ground movements, the preparation of underground thermocouple installations, and some studies of rock permeability. Of direct engineering interest are studies of the flow of steam/water mixtures in pipes, orifices, and nozzles. Measurement of absorption of beta rays across the flows in pipes carrying discharge from bores have produced promising ideas for the more accurate measurement of bore outputs, and will be supplemented by similar studies on air-water mixtures.

Collection of samples of the bore discharges at Wairakei was continued by the Dominion Laboratory and analyses were made of the gases, condensates, and waters. The newer production bores were sampled as opportunity offered. Further samples were taken from bores that had been discharging for a long time with the object of detecting any changes in composition that might throw light on the probable duration of the discharge.

As the ratio of arsenic to chloride in the waters may be of geochemical interest, determinations were made of the arsenic contents of waters from the Wairakei bores and from hot springs in other places.

Regular determinations were made of the chloride in the Waikato River above and below Wairakei. From a knowledge of the chloride content and temperature of the underground fluid tapped by the bores, the heat output of the Wairakei region was calculated.

A differential potentiometric method for determining very low concentrations of chloride in water was worked out, and this proved to be a rapid way of estimating the spray content of steam. A simple separator was designed which should give satisfactory separation of water from steam for power or other purposes. A further study was made of the flow of mixtures of water and steam through pipes.

The corrosive effect of geothermal steam on metals likely to be used in turbines and heavy-water plant was further investigated and useful results obtained.

Cement grout that had been underground at Wairakei for eighteen months was found to be soft, with little strength. There had been very serious leaching out of cement from the grout by contact with percolating water charged with carbon dioxide.

RADIOCARBON DATING

In last year's report the underlying basis of radiocarbon (^{14}C) dating was explained. During the year a substantial advance in technique has been made by officers of the Dominion Laboratory and Dominion Physical Laboratory working in close collaboration. The method evolved by workers in U.S.A. and used in initial work in New Zealand involved the preparation of pure solid carbon from the sample to be aged. These methods enabled only one sample to be processed per week and required exacting chemical purification of the material.

A new method has now been perfected in which purified carbon dioxide is isolated instead of purified elemental carbon. This not only simplifies the chemical processing, but also greatly increases the efficiency of the counting procedures. The solid carbon method permitted the age of carbonaceous material to be determined up to 20,000 years; the new gas-counting method extends this to 45,000 years. The new equipment is in routine operation and it is at the moment the most accurate system in existence in the world. The error of the New Zealand method is 0.2 per cent compared with 0.3 per cent to 2.0 per cent for various methods in use in laboratories in U.S.A.

The apparatus and techniques were described in the U.S.A. in a paper to a recent conference on ^{14}C aging and were referred to by a recent American scientific journal as "the high point of the conference".

PERLITE

Some acid volcanic rocks, notably glassy rhyolites, swell on heating to form a cellular product of light weight.

Ignimbrites, obsidians, pitchstones, and glassy rhyolites, collected by officers of the Geological Survey, were tested by the Dominion Laboratory for extent of swelling on heating and for final colour.

The ignimbrites and obsidians were found to have no value as perlites. The pitchstones were much inferior in swelling properties and colour to the rhyolites. Only the glassy rhyolites have commercial value as perlites.

The best perlite rocks available in quantity are at Ongaroto, Marua, and Tairua.

When heated rapidly to temperatures within the range 900° to $1,200^{\circ}$ C. the rock expands to as much as ten times its original volume producing material known as "expanded perlite". By control of furnace conditions bulk densities ranging from 2 lb. to 20 lb. per cubic foot may be obtained.

By far the most important use is to replace sand in hardwall and acoustic gypsum plasters. The advantages of perlite plaster over the old sand type are its lightness, high heat-insulating value, sound-absorbing properties, and easy workability. It lends itself to modern rapid methods of construction, can be applied by a spray gun and dries out rapidly. Expanded perlite can be used for loose-fill insulation and as an aggregate in light-weight (non-load-bearing) concrete.

INFRA-RED SPECTROPHOTOMETER

The double-beam recording infra-red spectrophotometer has now been in use in the Dominion Laboratory for over a year, and is proving extremely useful. Analyses that were almost or quite impossible by chemical methods can in many instances be made rapidly by measurements of infra-red absorption. Two beams of infra-red radiation are passed along similar paths through two cells containing a solvent, in one of which the substance to be determined is dissolved. The absorption of the radiation over a range of frequencies is recorded in the form of a curve on a chart, and from the position and height of the peaks the concentration of the substance can be calculated. The most useful applications so far have been the determination of the active parapara isomer in DDT and the gamma in BHC. The insecticides owe their potency to the isomers named, which are chemically almost identical with the inactive isomers that accompany them. At present the best practical method of distinguishing them is by their infra-red absorption.

A problem of the Fats Research Laboratory, the detection of "trans" acids in fatty acids, from the rumen of sheep was solved with the help of the Dominion Laboratory instrument. It was also used in the investigation of the compounds responsible for the spontaneous firing of wool in ships. Assistance has been given to university workers on problems involving the constitution of organic compounds, for which purpose the instrument is well adapted. The Laboratory is also using it to examine the "vehicle" in traffic paints, to detect cellulose nitrate in fabrics, and to discover the composition of smoke used for smoking bacon. As glass is not transparent to infra-red the optical parts of the instrument have to be made of sodium chloride, potassium bromide, or other similar crystals, which, unfortunately, are readily soluble in water. This makes it necessary to protect the apparatus from damp air, which would ruin the polished surfaces, and to dissolve the substances to be analysed in non-aqueous liquids such as carbon disulphide. This raises a serious difficulty if the substance to be examined is soluble in water, but not in a non-aqueous solvent. To overcome this special equipment is being obtained that will enable the substance to be compressed into transparent disks with powdered potassium bromide, thus eliminating the solvent altogether.

MEAT RESEARCH

Biochemical work on muscle proteins and connective tissue was continued. Further work was done on bone taint.

To determine the shrinkage that occurs in the chilling and ocean transport of beef the weights of carcasses were taken before and after chilling and after arrival in London.

To establish the best drying and smoking conditions to produce bacon of good keeping quality an experimental bacon-smoking unit was constructed. A study was made of the measurement and control of temperature, air flow, humidity, and smoke density.

A device for making continuous records of the weight changes in bacon during processing was installed and tested. The burning characteristics of sawdust were investigated. The effects of pre-slaughter treatment of pigs on the ultimate pH of meat and on the penetration of salt during curing were studied.

For dehydration of meat in pieces as developed earlier by the Laboratory an improved plant has been designed that will greatly simplify construction when it reaches industrial scale. A pilot plant to this design is being constructed.

Consumer trials with dehydrated meat made by the Laboratory process were carried out with the co-operation of the Army in New Zealand and in Malaya. The meat was also found satisfactory by the British Ministry of Food and by three Himalayan expeditions.

MASS SPECTROMETRY

In nature all the atoms of a given element are not of equal weight; for instance, heavy water contains hydrogen which is twice as heavy as the more common hydrogen atoms and in ordinary water one hydrogen atom in about 5,000 is a heavy one. These different hydrogen atoms are called isotopes. All elements have isotopes, e.g., carbon, nitrogen, oxygen; and sulphur, to name but a few.

The mass spectrometer is an apparatus for measuring the relative numbers of heavy and light atoms of an element, i.e., relative abundance of the isotopes. For example, it can measure the heavy-water content of natural waters. Briefly it works as follows. The material to be analysed, which must be in a gaseous state, is led into a small box through which is shot a beam of electrons from a white-hot tungsten filament. This electron beam charges the particles of the gas electrically. By means of electric fields, these charged particles are removed from the box and directed towards a specially shaped magnetic field in which they travel in arcs of circles, the lighter particles being bent more than the heavy ones. Associated with each beam of charged particles of a given weight is a minute electric current which is measured by a suitable collector. Comparison of these currents can be interpreted as a measure of the relative numbers of atoms of different weights in the original sample.

Variations in natural abundance of sulphur isotopes in high sulphur coals in relation to sea-water sulphur are being studied. Sulphur from the thermal regions and Australia is also used.

In association with Lincoln College the nitrogen economy of grass and clover grown together has been studied. Fertilizer containing the heavy nitrogen isotope was used.

A small mass spectrometer specifically for the analysis of heavy water has been designed and is being built. This will be used in association with the heavy water plant at Wairakei.

COOK STRAIT PROPAGATION

This work was originally begun in 1953 to try to reduce the degree of deep fading on a 9 cm. optical radio link across Cook Strait by so siting the terminals that the sea-reflected radio ray was prevented by intervening land from reaching the receiver. An experimental link was run from November 1953 to the beginning of May 1954. Some improvement in performance was obtained, but better performance could be expected by adjusting the terminal heights. A paper on this phase of the work was presented at the Science Congress in May in which a simple quantitative theory was tentatively formulated to explain the signal strength distribution curve obtained.

Early this year two receivers were installed about 60 ft. apart in height, and through the courtesy of the Civil Aviation Administration special flights have been arranged to study atmospheric refractive index conditions over Cook Strait. It is hoped that the combined radio and meteorological observations will lead to the establishment of a quantitative theory for determining the signal strength distribution curve.

IONOSPHERIC WINDS

For several years there has been an international programme initiated by the Cavendish Laboratory in Cambridge, England, for regular observation of "winds" in the ionosphere, i.e., upper layers of the earth's atmosphere. Hourly measurements are made for seventy-two hours each month simultaneously at stations round the world, and for over two years New Zealand has contributed to this programme. This year an appreciable amount of work has been done on the theoretical principles behind this work, and a number of practical trials have been carried out to test various hypotheses. A new method of analysing the records has been devised and a new "moving aerial" technique for measuring the ionospheric winds is being considered. The new work was recently discussed at a very successful one-day symposium held at the Dominion Physical Laboratory.

ENGINEERING SEISMOLOGY

During this year a more concerted attack has been made on the subject of engineering seismology. The most valuable development has been the appreciation that the movement of structures at large amplitude involves the study of structures in the yield condition. To do this an electrical analog is being built which incorporates yield conditions: with this we shall be able to study the performance of a multi-storey building in an earthquake. Some inquiry into the properties of foundations has been made but to have real applicability to earthquake conditions they will have to be repeated on a much larger scale than is at present possible.

APIA OBSERVATORY

Because of its geographical location in the central Pacific Ocean, Apia Observatory is one of the most important observatories in the world for the study of seismology and geomagnetism on a global scale. It was established by the Germans before the 1914-18 war and since then has been the responsibility of the New Zealand Government. The necessity to replace the old equipment which now falls far short of international standards has been emphasized at numerous international conferences. Modern seismographs and magnetographs have been purchased and are under test in New Zealand. When the observatory buildings at Apia have been modified and the new instruments installed later this year, New Zealand will be operating an observatory of which it can be justly proud.

MAGNETIC CHARTS

Numerous reports of abnormal magnetic variation around the New Zealand coast have been received by the Marine Department from masters of overseas ships. In view of the importance of this matter for navigation purposes, the Department has reviewed these reports and advised the Marine Department that special magnetic variation obser-

vations are required only in the Cook Strait and Foveaux Strait areas. The Department has designed a system for carrying out such observations from the air, utilizing equipment that is available from D.S.I.R. and Air Department sources. As the Department is responsible for the annual revision of sea and air magnetic charts in the south-west Pacific Ocean, it has agreed to carry out this work in the near future.

OCEANOGRAPHY

The Department has proceeded with the establishment of the New Zealand Oceanographic Institute. Temporary accommodation has been secured and marine biologists have commenced preliminary investigations of the distribution of plankton in New Zealand waters, and the animal population of the continental shelf. As plankton is the primary source of food for marine life, this survey will have an important bearing on all future fisheries investigations. During the latter part of the year the physical oceanography group carried out observations of the physical properties and surface currents of New Zealand coastal waters. This work is an essential preliminary to both larger scale and more detailed studies of the oceanic circulation around New Zealand, and to an understanding of some of the factors controlling the distribution of marine life. The Royal New Zealand Navy is also interested in this work and has provided invaluable ship time for this purpose.

NEW CONSTITUENTS IN ANIMAL FATS

Until recently it has been accepted that the glycerides of natural fats (except those of porpoises and dolphins) are made up of saturated and unsaturated straight chain fatty acids that contain an even number of carbon atoms. The work of the Fats Research Laboratory over the past five years, however, has established that, in addition to the straight-chain saturated and unsaturated acids, there are present in fats branched-chain acids and saturated acids with an uneven number of carbon atoms.

Branched-chain Fatty Acids.—The branched-chain fatty acids so far isolated from butterfat, mutton, and ox fats are notably the *iso* and *anteiso* acids of the C_{15} and C_{17} series, but include also other acids with from one to four methyl branches within the range C_{14} to C_{20} . These constituents were originally isolated in amounts corresponding to less than 0.1 per cent of the total fatty acids. Our more recent work, however, in which an improved fractionating column was employed, showed that butterfat contained 0.37 per cent of C_{15} *iso* acid and 0.43 per cent of the C_{15} *anteiso* acid.

Straight-chain Fatty Acids Containing an Odd Number of Carbon Atoms.—Further investigations on hydrogenated mutton tallow have shown the presence of 1.2 per cent n-heptadecanoic (margaric) and 0.15 per cent n-pentadecanoic acids. Similarly, butterfat was found to contain 0.82 per cent of pentadecanoic acid, while from shark (*Galeorhinus australis*) liver oil 0.29 per cent of n-pentadecanoic and 0.17 per cent of n-heptadecanoic acids were isolated.

Conclusions.—(1) The existing ester fractionation analyses of fats need to be amended, in certain instances at least, to include the branched-chain and n-uneven-numbered acids. (2) The current theory of biosynthesis of fatty acids involving the condensation of "acetate" alone cannot explain the occurrence of branched-chain and uneven-numbered carbon fatty acids in natural fats.

Effect of the Rumen on the Dietary Fat.—As the inclusion of fatty acids in the diet of pigs leads to the production of undesirably soft carcasses, it might be anticipated that the fatty oils (containing mainly linolenic acid) in pasture would have a similar adverse effect on the carcasses of pasture-fed animals. This is indeed the case with rabbits and horses whose fats are soft and rich in linolenic acid. The Fats Research Laboratory has shown that the fats of pasture-fed ruminants have only traces of this acid, and that differences between the fats of pasture-fed ruminants and non-ruminants are due to hydrogenation of the dietary fat by bacteria in the rumen. As hydrogenation produces *trans*-acids, it is possible to explain our recent observation that the fats of non-ruminants contain less than 0.2 per cent *trans*-acids, while those of ruminants have 4 to 10 per cent of these acids. It is fortunate that linolenic acid is not extensively deposited in the milk and depot fats of ruminants as this would adversely affect their keeping quality. By enhancing the bacterial action in the rumen, through an increased intake of roughage, it may be possible to reduce still further the linolenic acid content of butter and of meat fats and thereby improve their keeping quality.

Physical Properties of Fats.—It has long been thought that the unique properties of cacao butter used for chocolate manufacture depend on glyceride structure, and this view is supported by the fact that mutton tallow, though of similar fatty acid composition, is greasy and lacks the snap and brittleness possessed by cacao butter. It would be economically desirable to convert mutton tallow to a cacao-butter substitute, but to achieve this much more will need to be known about the effects of glyceride structure on the properties of fats. To assist in this direction glycerides of known structure have been synthesized by the Fats Research Laboratory.

X-ray measurements of binary fatty acid mixtures have been continued in collaboration with the Soil Bureau and have led to the elucidation of compound formation between acids such as palmitic and stearic. Mixtures of these two acids find extensive industrial application in the form of so-called stearine or technical stearic acid, and the above alleged compound formation influences greatly the physical properties of the product.

BAKERY MECHANIZATION

For many years machines have been widely used in New Zealand for certain steps of the traditional batch process for making of bread, but in only a few of the largest bakeries had mechanization gone so far as to change the process to a more or less continuous one. The recent introduction of smaller "travelling" ovens has now led to semi-continuous production in many bakeries.

Formerly it was usually possible to treat the baking process as a series of distinct steps, and bakers were able to make changes at one point in the process without fear of causing difficulties at others. With continuous baking it is very desirable that there should be no breaks in the feed of dough to the oven, and since time and temperature play an important part in many stages of breadmaking, it is necessary that no changes are made unless the effect on the timing of the subsequent operations can be foreseen. In this respect the planning of production in New Zealand bakeries, which make many varieties of bread, is much more difficult than in England and the U.S.A. where perhaps only one or two varieties are made in any one unit.

Several projects in progress at the Wheat Research Institute are related to this development. Slide rules have been designed for the purpose of making a number of calculations relating other baking operations to the output of travelling ovens; a graphical method for setting out the work of an automatic bakery has been developed and is being tested under practical conditions; equipment has been made to reproduce the conditions existing in certain machines so that data needed by bakers can be obtained in the laboratory, and the Wheat Research Institute's staff is taking part in the planning of operations where new equipment is being brought into use. The Institute's past work on the control of dough maturity and final proof rate has provided the means by which dough behaviour may be adjusted to fit the rates of working of the key machines.

The main purpose of this work is to keep the Institute in touch with current bakery practice and to develop techniques for the solution of problems in mechanized bakeries.

INFORMATION BUREAU

The Information Bureau is responsible for the editing and publishing of departmental publications, and, in addition, it includes the Central Library, Technical Information Section, Public Relations Officer, Photographic Section, Translation Section, and Photo-copy Service.

Both sections (Agricultural Research and General Research) of the *New Zealand Journal of Science and Technology* have increased appreciably in size during the year and prompt publication has been maintained. The *Journal* is, in general, for the publication of articles embodying the results of original scientific research work in practically all branches of pure and applied science. Papers are required to be based on work carried out in New Zealand or on New Zealand material or, in special cases, to have some other connection with New Zealand.

During the past twelve months the Information Bureau has edited and published some twenty bulletins and major publications on behalf of the branches of the Department. Additional departmental publications, apart from the *Journal*, handled by the Bureau included the annual report, *Dairy-farm Survey of Waipa County 1940-41 to 1949-50* and a second edition of the *Departmental Handbook*.

Important technical inquiries dealt with by the Bureau during the year numbered 450, half of which were from manufacturers and one-third from Government Departments and local authorities.

This Department's contribution to the *Industrial Bulletin*, published jointly with the Department of Industries and Commerce, has comprised over 200 technical articles and abstracts, the latter mainly from overseas scientific journals. Some 300 requests were received for the full articles on which the abstracts were based.

Close contact has been maintained with the press by the arranging of interviews and the supplying of information, in addition to the issue of press releases to all the New Zealand newspapers, a selection of magazines, and overseas organizations.

Special work undertaken by the Photographic Section included aerial photographs of fluorescein patches in Lyttelton Harbour to show tidal drifts, cine-photographs of certain phases of the eruption at Mount Ngauruhoe, and the design of a camera for the rapid photographing of bathythermograph slides (for recording the temperature of sea water at depth).

SCIENTIFIC LIAISON SERVICE

The Department's Scientific Liaison Offices in London and Washington continue to render a most valuable service by keeping the Department advised of recent and important scientific and technical developments overseas. By direct contact with overseas research organizations, to which the Department is greatly indebted, liaison officers obtain a great deal of valuable information that would not normally reach research workers and industry in the Dominion.

Dr E. Marsden, Scientific Adviser, London, relinquished the appointment during the year and returned to New Zealand prior to his retirement from the Public Service.

It is desired to place on record the Department's sincere appreciation of the very valuable contribution that Dr Marsden made to the work of the Department while acting as Scientific Adviser in London. Dr V. Armstrong, formerly Assistant to Dr Marsden, has been appointed Scientific Liaison Officer in London.

In London and Washington the Department's representatives are associated with liaison officers from other parts of the Commonwealth to form, in each capital, a British Commonwealth of Nations Scientific Liaison Office (B.C.S.O.). This arrangement has greatly facilitated co-operation and the approach, on a Commonwealth basis, to major projects of outstanding importance.

COMMONWEALTH AGRICULTURAL BUREAUX

One of the most successful activities being conducted on a Commonwealth-wide basis in the field of science is that of the Commonwealth Agricultural Bureaux (C.A.B.).

The organization consists of ten Bureaux, three Institutes, and a Headquarters, all but one of which are located in the United Kingdom, which prepare and publish abstracts of and monographs based on the world's scientific literature in the fields of agriculture and forestry. This and the other services of the C.A.B. enable research and extension workers to keep up to date with the rapid developments in these and related subjects.

Every five years a conference of representatives of the contributing countries is held to review the policy of the Bureaux and to determine the funds required for running the Bureaux during the next five-year period. In the periods between these quinquennial Review Conferences the activities of the Bureaux are controlled by an Executive Council in London on which the participating Commonwealth countries are represented. New Zealand's representative on the Executive Council is Dr Armstrong, our Scientific Liaison Officer in London. The funds of the Bureaux are provided by the Governments concerned and by the sale of Bureaux publications.

A Review Conference is being held in the United Kingdom in 1955. The New Zealand delegates are the Secretary of the Department of Scientific and Industrial Research, the Director of the Extension Division of the Department of Agriculture, and our Scientific Liaison Officer in London.

GRANTS TO OTHER INSTITUTIONS

Apart from the incorporated research associations, grants were continued for research in the University (£29,335), and much valuable work is being undertaken. Such grants are closely co-ordinated with those made by the Research Committee of the University in order to avoid duplication and ensure the most efficient use of the funds available.

The grant (£11,133) to the Cawthron Institute was continued to enable the Institute to maintain its wide range of activities in the Nelson area and to undertake specialist chemical research in co-operation with departmental branches, such as the Tobacco and Hop Research Stations. The grant to the Royal Society of New Zealand was maintained at £4,000 to cover increased costs of printing and to assist the Society to fulfil its role as the senior scientific society in the Dominion.

CONCLUSION

The Department has continued to receive generous co-operation from other State Departments, the Cawthron Institute and the University colleges, overseas scientific organizations, and from both farming and manufacturing interests. The good relations that have prevailed have been much appreciated and have greatly assisted the promotion of the Department's objectives.

In conclusion, I would thank the staff of the Department for their help and co-operation during the year, and also express my personal indebtedness to the Council of Scientific and Industrial Research and its advisory committees for the assistance they have generously rendered on all occasions.

W. M. HAMILTON, Secretary.

BRANCHES

ANIMAL ECOLOGY SECTION

Officer in Charge: Dr K. WODZICKI

PROJECTS COMPLETED

Research on Rabbits.—Analysis of data on reproduction of rabbits in Hawke's Bay with regard to the duration and intensity of the breeding season, prenatal mortality, productivity, seasonal variation in age-composition of the population, and the effect of age on reproduction; investigation of the incidence of parasites, the inter-relationship of host and parasite population and mortality rates in rabbits in Hawke's Bay (in co-operation with the Applied Mathematics Laboratory); and a study of natural mortality of the rabbit (in co-operation with Applied Mathematics Laboratory).

Other Studies.—An investigation into the feeding habits of rabbits and hares; and a study of the distribution and taxonomy of the kiore or native rat.

PROJECTS UNDER WAY

Research on Rabbits.—Investigations into the reproductive activity in relation to environment and season; investigation on interaction between infestation by *Coccidia* and type of pasture; geographical distribution of three species of nematode worms of rabbits; parasitic fauna of rabbits from Subantarctic islands (Macquarie and Auckland Islands); growth studies with the view of improving methods of age determination; census methods—dropping and sight counts (in co-operation with the Applied Mathematics Laboratory); ecology of residual populations; distribution and habitat requirements of the wild rabbit in New Zealand; rabbit predators (ringing study of the harrier-hawk).

Research on Other Animals.—Local surveys: mammals and birds of Western Taupo, and reconnaissance of the Auckland Islands group; investigation of New Zealand magpies; and life history, dispersal, and population study of the gannet.

PUBLICATIONS

Population Regulation in Rabbit Nematodes. *Nature* 175:218–9. P. C. Bull.

Ringling Operations Summary for the Year ended 31 March 1954. *Notornis* 6:14–8. P. C. Bull.

Recovery of Ringed Harriers. *Notornis* 6:6–10. J. S. Watson.

Reingestion in the Wild Rabbit. *Proc. Zoo. Soc. London* 124 3:615–24. J. S. Watson.

Reingestion in the Hare. *Science* 121–314. J. S. Watson and R. H. Taylor.

Breeding Season of the Wild Rabbit in New Zealand. *Nature* 174:608. J. S. Watson.

Observations on the Diving of the Australasian Gannet (*Sula bassana serratior* Gray). *Notornis* 6:72–6. K. Wodzicki and F. H. Robertson.

APPLIED MATHEMATICS LABORATORY

Director: Dr R. M. WILLIAMS

PROJECTS

Design and analysis of experiments undertaken for other organizations on many topics, including use of insecticides on crops, pressure impregnation for preservation of timber, control measures for various plant diseases, growing and storage of apples, animal research, pasture in hill country, pumice-land development, and plant physiology and breeding.

Statistical work on rabbits for Animal Ecology Section, including investigation of periodic fluctuations in New Zealand rabbit population, study of variation with age of susceptibility of rabbits to certain parasites, estimation of rabbit populations and mortality rates, and estimates of effect of reabsorption of embryos on rabbit population.

Developments in stochastic processes (required in the interpretation of ecological and geophysical data): work on reversibility and the moments of transition probability of a Markov chain, study of autoregressive schemes with periodic coefficients and non-linear effects, and study of the probable configuration of inter-acting particles.

Improvements in statistical techniques: study of spatial point processes for ecological problems, extension of analysis of covariance to time replicated cases for perennial crops, development of partially balanced incomplete block designs and of randomization tests, and examination of the power of the chi-squared test to distinguish the Poisson from the negative binomial series.

Miscellaneous: statistical aspects of determining degree of pollution of harbours, mode of oscillation of simple multi-story buildings in earthquakes, statistical problem in installing quality control system in industry, contribution to study of evaporation process at Grassmere salt works, and survey of turnover of technicians in the Dominion Physical Laboratory.

PUBLICATIONS

- A Method of Calculating Fatty Acid Composition from Ester Fractionation Analysis. *J. Am. Oil Chem. Soc.* 31:473-5. E. W. Jones and M. A. MacLean.
- Earthquake Distributions in the Central and Southern N.Z. Regions. *N.Z. J. Sci. Tech.* B36:347-50. W. B. Taylor.
- Analysis of Virus Local Lesion Experiments. *Ann. App. Biol.* 41:667. P. R. Fry and W. B. Taylor.
- A Note on Some Theory Relating to the Diffusion of Chemicals into Green Timber. *N.Z. J. Sci. Tech.* B36:533-6. A. McNabb and W. B. Taylor.
- A Note on Contagious Distributions. *Biometrika* 41:268-71. H. R. Thompson.
- The Statistical Analysis of a Seiche Record. *J. Marine Research* 13:76-100. P. Whittle.
- A Statistical Analysis of Sunspot Observations. *Astrophysical J.* 120:251-60. P. Whittle.
- On the Stationary Processes in the Plane. *Biometrika* 41:443-9. P. Whittle.
- Optimum Preventative Sampling: *J. Operations Res. Soc. Am.* 2:197-203. P. Whittle.

- Some Recent Contributions to the Theory of Stochastic Processes—Appendix to H. Wold's book *A Study in the Analysis of Stationary Time Series*—2nd edition. Upsala, 1954. pp. 196–228. P. Whittle.
- Review of J. Neyman's "Lectures and Conferences on Mathematical Statistics and Probability". *Econometrica* 22:533–4. P. Whittle.
- Sampling Systems for Dependent Data. *Proc. N.Z. Soc. Animal Production*. 14:118–20. R. M. Williams.

AUCKLAND INDUSTRIAL DEVELOPMENT LABORATORIES

Director: Mr J. B. BROOKE

PROJECTS

Medical Instrumentation.—Cardiac clinic: instrumentation for hypothermia experiments, application of oximetry, construction of infant tracheal tubes, development of improved pulse-rate recorder, and measurement of blood volume and cardiac output.

National Women's Hospital: uterine activity recorder, cervical dilatation recorder, pitocin drip rate recorder, detection of breathing failure in premature infants, foetal pulse-rate recorder, and infant resuscitator.

Neurosurgical: electromyography; blood-pressure recorder for Wellington Hospital Board; and cardiac defibrillator for Otago Hospital Board.

Animal physiology: equipment for recording rumen pressures existing in the normal and bloated state, and rectal temperature indicator for guinea pigs.

Fuel Technology.—Steam survey at a local tannery; determination of calorific value of Kraft black liquor; steam flow and temperature measurements in timber products factory; investigations of boiler failure, and boiler explosion; and problems associated with grit arrestor installation at Kings Wharf Power Station.

Metallurgy.—Properties of New Zealand sands and clays for foundry work, mechanical testing of a wide range of materials, gamma radiography, and examination of failed components of vehicles and machines.

Physics and Electronics.—Investigation of twin-T filter characteristics; equipment for determination of tree-sap flow rates; thermistor temperature recorder; strip elements for glue curing; special water manometer for venous pressures; experiments to determine possibility of using water vapour clouds for frost prevention; measurement of vibrations due to blasting at Waitaki and Roxburgh; development of cloth colour comparator; and recommendations for modifications in testing procedure for hot-water cylinders.

Design and Workshop.—Development of plasma and industrial filters; hopper feeds for ammunition inspection; encephalometer for X-ray measurements of skull proportions; development of magazine-wrapping machine; assistance to blind instructor in the development of a musical instruction system; design of high-pressure pellet moulds for Soil Fertility Station, Rukuhia; recommendations for melting plant for bituminous filling compounds; use of strain gauges for pre-stressed concrete beam investigation, for calibration of plywood press, and for investigation of press frame failure; investigation of tractor winch failures; special servicing of dynamic balancing machine; and special servicing of rail-track recorder.

BOTANY DIVISION

Director: Mr C. M. SMITH

PROJECTS

The principal projects under way are as follows:

Preparation of revised and third edition of Cheeseman's *Manual of New Zealand Flora*; preparation of a manual of New Zealand adventive plants; and preparation of a chromosome atlas of New Zealand plants (present special study: New Zealand gymnosperms).

Palynology: plant remains in Quaternary strata, melitopalynology, limnology, and revision of pollen structure of *Nothofagus* spp. (including introduced species flowering in New Zealand).

Systematy of New Zealand grasses; breeding and ecology of local forms of indigenous "Bluc Grass" (*Agropyron scabrum*); and cultivation and breeding of *Phormium tenax*.

Ecology of South Island tussock grasslands: vegetational changes in progress at Molesworth Station; and growth and seasonal habits of species under trial as pasture introductions.

Maintenance and upkeep of herbaria: herbarium of indigenous plants; herbarium of adventive and cultivated plants; and seed herbarium.

Collection and distribution of seeds of indigenous plants and annual issue of an Index Seminum; and recording of introduction of seeds from overseas for scientific and commercial purposes.

Establishment in Canterbury of a botanic gardens for the conduct of the Division's observations and experimental work, and for maintenance of a reference collection of growing plant material.

Study of New Zealand freshwater plants and their distribution.

PUBLICATIONS

Variation in a Sample of *P. radiata* Cones from the Nelson District. *Trans. Roy. Soc. N.Z.* 82:25-40. M. H. Bannister.

The Origin of New Chromosomes in *Agropyron*. Suppl. to *Heredity* 6: 215-33. J. B. Hair.

The Quaternary in New Zealand. *Rapports et Communications à Section Six, 8^e Congrès International de Botanique, Paris*. 268-9. W. F. Harris.

Progress Report on Pollen Statistics from Pyramid Valley Swamp. *Rec. Cant. Mus.* IV (4):279-90. W. F. Harris.

Contributions to a Knowledge of the Naturalized Flora of New Zealand: No. 4. *Trans. Roy. Soc. N.Z.* 82:263-9. A. J. Healy.

Population Fluctuations in Adventive Species in New Zealand. *Proc. N.Z. Ecol. Soc.* 2:8-10. A. J. Healy.

Some *Rumex acetosella* Communities in New Zealand. *Vegetatio Acta Botanica V-VI*. 268-78. Lucy B. Moore.

Peat Profiles, Whareroa Block, Paekakariki, New Zealand. *N.Z. J. Sci. Tech.* A36:221-31. N. T. Moar.

Index Seminum anno MCMLIV collectorum. p. 10. Divisional Publication.

The High Altitude Snow Tussock Grassland in South Island, New Zealand. *N.Z. J. Sci. Tech.* 36A:335-64. H. E. Connor (compiler).

The Ecology of the Snares Islands: Part III. *Cape Expedition Series Bull. No. 13* 1953. W. F. Harris.

CROP RESEARCH DIVISION

Director: Dr E. J. GODLEY

FIELD-CROP PROJECTS

Wheat.—Breeding for the following: a general-purpose wheat of Cross 7 type with higher yields; an early-maturing variety that will not lodge, to replace Tainui in the North Island; a high-yielding wheat with stiff straw and tight chaff for high-fertility land where Dreadnought is grown; a high-quality wheat with higher yields than Hilgendorf; lines of commercial varieties resistant to mildew; and spring wheat suitable for mid-Canterbury.

Wheat Genetics Studies.—Inheritance of kernel weight, grain-shattering, protein, mildew-resistance, and yield studies of varietal mixtures.

Wheat Disease Survey.—Annual surveys, for five years, of a representative sample of Canterbury wheat crops.

Oat Breeding.—Lodging-resistant milling oats; lines of commercial varieties resistant to crown rust; and introduction and testing of promising overseas varieties.

Barley.—Work confined to the introduction and testing of new overseas varieties.

Potato Breeding.—Resistance to blight (*Phytophthora infestans*); resistance to viruses X, Y, and leafroll; and improved agronomic characters.

Virus-free Stocks of Potatoes.—Selection of virus-free plants of commercial varieties and maintenance of nucleus stocks; and annual testing of virus-free stocks that are being increased by the Department of Agriculture.

Potato Virus Diseases.—Study of the natural spread of virus diseases, methods of eliminating virus from infected stocks, methods of testing for virus content and virus resistance, study of the nature of resistance and of gene action, and the effect of environment upon resistance.

Potato Blight.—Study of blight strains in New Zealand and of their origin, study of the nature of resistance and of gene action, and the effect of environment upon resistance.

Swedes.—Breeding for resistance to dry-rot and club-root; and investigation of resistance to aphids.

Rape.—Breeding for resistance to aphids by crossing with resistant swedes; and breeding for improved agronomic features in club-root resistant rape.

Lucerne.—Breeding for an improved grazing type of lucerne, and for earlier spring growth.

Linseed.—Producing rust-resistant varieties by transferring resistance to commercial varieties.

Linen Flax.—The transference of rust-immunity to Liral Crown and Concurrent by hybridization and back-crossing.

Lupins.—Investigations of factors affecting pod-setting; assembling wild material from other countries to obtain types with large numbers of small seeds, for use in increasing seed production; and breeding a yellow lupin with non-shattering and non-bursting pods with an improved seed yield.

VEGETABLE PROJECTS

Dwarf Beans.—Breeding for halo-blight resistance; and estimation of the amount of natural crossing.

Pole Beans.—Breeding for rust-resistance; and selection and comparison of strains of the variety Fardenlosa.

Tomatoes.—Improvement of fruit shape in Mangere Pale-leaf; a search for resistance to spotted wilt in a promising cross, Pearl Harbour × Rey de los Temperanos; the influence of the maternal parent on yield in hybrid tomatoes; and investigations into the production and use of first generation hybrids in outdoor tomatoes.

Savoy Cabbage.—The production of uniform late-maturing strains in the variety Best of All.

Spring Cabbage.—The development of a uniform strain of the variety Flower of Spring.

Cauliflower.—The development of strains of winter cauliflower, with improved yield and uniformity in maturing time.

Peas.—The inheritance of immunity to the pea mosaic virus, transference of mosaic immunity to wilt-resistant Greenfeast, and the effect of the rogue character on seed characters in Onward peas.

Kumara.—Formation of a collection of true Maori varieties.

Onions.—Selection for white rot resistance in Pukekohe Long Keeper; and study of male sterile strains for use in hybrid onions.

NUCLEUS SEED PRODUCTION

Each year pure seed of some forty crop varieties is produced to provide nucleus seed for the seed certification scheme of the Department of Agriculture.

AGRONOMY PROJECTS

Crop Ecology

Preparation of a map of the major environmental factors for the main cropping regions.

Forage Crop Measurement Techniques

Lamb-fattening Forages.—Measurement of total crop weight, stubble loss, grazing loss, weight of feed consumed together with digestibility, and live weight increases of grazing wethers.

Cereal Greenfeeds.—Measurement of yield under a mowing technique, Lynch's herbage return technique, and Sear's proportionate return of dung and urine technique, using N.I.A.B. ryecorn and Winter Grey Oats.

Yield Trials

Rape.—Effect of variety, nitrogen, and spray irrigation on yield and fattening ability.

Growth Rate Trial.—Time of sowing, interval between cuttings, and number of cuttings on forage and seed yield of Dun and Algerian oats.

Legume-Non-Legume Crop Associations and Nitrogen Top-dressing.—Broad Leaf Essex II rape and Borre lupin, cereal greenfeeds with Broad Red and Crimson clovers and Serradella, and sulphate of ammonia at sowing and in April with cereal greenfeeds.

N.I.A.B. Ryecorn Improvement.—Polycross block and progeny testing followed by seed increase of selected lines to provide nucleus seed for certification.

Rust of Cereal Greenfeeds.—Measurement of the effect of rust on yield and quality of Dun oat forage.

Wheat.—The yield and quality response of Cross 7 wheat to urea sprayed at different times and rates.

PUBLICATIONS

Soil Conservation Surveys in New Zealand. *N.Z. J. Sci. Tech.* A35:505–17. A. F. Greenall and D. Hamilton.

Seed Variation in Pea Rogues. *N.Z. J. Sci. Tech.* A36:117–21. D. E. Yen.

Resistance of Swede Varieties to Dry Rot (*Phoma lingam* (Tode) Desm.). *N.Z. J. Sci. Tech.* A36:122–8. I. A. M. Cruickshank and T. P. Palmer.

Development of the Fibre Population in N-type Sheep. *Aust. J. Agric. Res.* 5:490–502. A. S. Fraser, J. M. Ross, and G. M. Wright.

Kemp Succession in N-type Sheep. *Aust. J. Agric. Res.*, 5:503–10. J. M. Ross and G. M. Wright.

Use of Honey Bees as Pollinators in Unheated Glasshouses. *N.Z. J. Sci. Tech.* A36:232–6. Greta Priestly.

DOMINION LABORATORY

Director: Mr F. J. T. GRIGG

PROJECTS

Chemical Engineering.—Dehydration of meat, fused phosphate fertilizer, experimental steam-boiler installation, purification of geothermal steam, manufacture of phosphorized pollard, and manufacture of lemon oil.

Minerals, etc.—Perlite; glassy rocks (minerals); investigation of palagonite (soils); rapid methods of rock analysis; and cement and concrete pozzolans, aggregates, and heats of hydration.

Organic, etc.—Certification of pesticides, foaming of *Pinus radiata* extracts, and extractives of larch heartwood.

Food and Drugs.—Adulteration of food and drugs; metal contamination of foods; foreign matter in foods; bacteriology of dairy products, etc.; fluorination of water; and purification of water.

Physical Chemistry, Metals, and Corrosion.—Infra-red spectra of organic compounds, spontaneous ignition of wool, corrosion of metals in geothermal steam, and corrosion of aircraft by top-dressing chemicals.

Paint.—Outdoor exposure of paints; under-water paints; metal-priming paints; metal-protective paints for thermal regions; road-marking paints; rust removers; and paint specifications.

Petroleum and Road Materials.—Analysis of lubricating oils and oil fuels, examination of aircraft fuels, foaming of aircraft engine oils, analysis of road-making materials, and investigation of road binders derived from coal-tar and petroleum.

Geothermal.—Analysis of gases, condensates, and waters at Wairakei and in other thermal districts; and arsenic content of geothermal bore waters.

Meat.—Study of meat proteins, relaxation "factor", connective tissue, weight losses in transport of chilled beef, ultimate pH in pig muscles, bacon, and bone taint.

PUBLICATIONS

- Arsenic and Lead Residues on Apples. *N.Z. J. Sci. Tech.* B35:311-4. P. J. Clark and H. Jacks.
- Mercury Residues on Tomatoes. *N.Z. J. Sci. Tech.* B35:301-6. H. M. Stone, P. J. Clark, and H. Jacks.
- The Occurrence of Trans Acids in Animal Fats. *Nature.* 174:85. L. Hartman, F. B. Shorland, and I. R. McDonald.
- The Quantitative Infra-red Analysis of Mixtures. *Nature.* 174:703. I. R. McDonald.
- Perlite Deposits in New Zealand: Part II. Evaluation. *N.Z. J. Sci. Tech.* B36:208-26. L. R. L. Dunn and W. M. Billingham.
- Shortening and Extensibility in Rigor Mortis. *Biochim. Biophys. Acta,* 12:478. B. B. Marsh.
- Rigor Mortis in Beef. *J. Sci. Food. Agric.* 5:70. B. B. Marsh.
- Rigor Mortis. *Proc. Internat. Inst. Refrigeration, Madrid, 1954.* B. B. Marsh.
- C-terminal Groups in Myosin, Tropomyosin, and Actin. *Biochim. Biophys. Acta.* 14:553. R. H. Locker.
- The Metal-finishing Industry in New Zealand. *International Review of Metal Finishing, London, 1954.* 127-35. S. H. J. Wilson.
- Bacteriological Survey of Auckland Harbours: Part I. *N.Z. J. Sci. Tech.* B36:129. G. M. Wallace and L. E. Newman.
- Arsenic Residues on Apples. *N.Z. J. Sci. Tech.* B36:344-6. P. J. C. Clark and H. Jacks.
- Carbon Dioxide as Substitute for Solid Carbon in ^{14}C Measurements. *N.Z. J. Sci. Tech.* B36:363-70. T. A. Rafter.
- New Zealand ^{14}C Age Measurements: II. *N.Z. J. Sci. Tech.* B36:371-4. G. J. Ferguson and T. A. Rafter.
- Wartime Search for Uranium in New Zealand. *N.Z. J. Sci. Tech.* B36:375-96. D. S. Nicholson.
- Spectrochemical Determination of Germanium in Silicates. *Analytical Chemistry* 26:737-8. P. G. Harris.
- The Distribution of Germanium Among Co-existing Phases of Partly Glassy Rocks. *Geochimica et Cosmochimica Acta* 5:185-95. P. G. Harris.
- Mordenite as an Alteration Product of a Pitchstone Glass. *Amer. Mineralogist* 39:819-24. P. G. Harris and G. W. Brindley.
- Kinetics of Liquid Film Processes in Gas Absorption: Parts I, and II. *Trans. Inst. Chem. Engrs.* 32:S49. A. M. Kennedy (with P. V. Danckwerts).

DOMINION PHYSICAL LABORATORY

Acting Director: Mr I. D. Dick (Assistant Secretary)

PROJECTS

Geothermal.—Physics of the thermal area; systematic measurements of temperature and flows, and other factors, from selected hot springs, geysers, etc., in Wairakei Valley, Waiotapu, Orakei Korako, Kuirau Reserve (Rotorua), and Te Teko; measurement of water content of steam; measurement of the density, in critical flow nozzles of the bores at Wairakei, by the absorption of beta radiation, to give the quantity and quality of steam and water mixture; an attempt to correlate quantitatively data on typical New Zealand geysers with current theory of geyser action; and a long-term investigation of two-phase fluid flow.

Concrete.—Investigation of the value of Whirinaki and Kaimai pozzolanic deposits for the manufacture of concrete.

Sulphur in Coal.—Detection by mass spectrometer of changes in sulphur isotope ratios in high-sulphur coals.

Radio Research.—Measurement of rapid fading of ionospheric signals, to determine winds in ionosphere; investigation of propagation conditions in Cook Strait region at frequency of 3,000 mc/s; reflection of radio waves in microwave region from the sea surface; and construction of panoramic ionospheric sounder.

Engineering Seismology.—Strong-motion seismographs of four types, to be located throughout New Zealand for recording the characteristics of strong-motion earthquakes; effect of foundation conditions on the earthquake-resistant properties of a structure; and an analogue computer for studying the effect of strong earthquakes on multi-storied buildings.

Optical Design.—Investigation of the optical properties of glasses, and of natural and synthetic colourless transparent cubic crystals; and design of general-purpose aplanats for stock designs from which many lens systems can be built with a little modification.

Application of Physical Methods for Biological and Agricultural Problems.—Electron microscopy of human dentine (in conjunction with Dental School, University of Otago); determination of virus particle concentration in saps from virus-infected plants; assistance to Plant Diseases Division in compiling a census of soil fungi; classification of soil colloids; determination of age of carbonaceous material between 50–45,000 years by ^{14}C measurement; nitrogen economy of grass-legume association using ^{14}N -labelled compounds fed to grass and clover; and soil temperature and soil moisture measurements.

Standards.—Establishment of standards of physical measurement in length, mass, temperature, pressure, photometry, radiation, and air velocity; and establishment of standards of electrical measurement at direct current, power, and radio frequencies.

PUBLICATIONS

Radiocarbon Dating System. *Nucleonics* 15:18–23. G. J. Ferguson.
New Zealand ^{14}C Age Measurements. II. *N.Z. J. Sci. Tech.* B36:371–4.

G. J. Ferguson and T. A. Rafter.

Note on the Selection of Observers for Primary Standard Optical Pyrometry. *Brit. J. App. Phys.* 5:227–8. M. C. Probine and Mrs S. Bertaud.

- Solarisation of Polymethylmethacrylate. *Brit. J. App. Phys.* 5:454. K. J. McCree.
- The new "Utility" Open Fire. *N.Z. Engineering* 9:265-6. L. Bastings.
- A Note on Some Theory Relating to the Diffusion of Chemicals in Green Timber. *N.Z. J. Sci. Tech.* B36:533-6. A. McNabb and W. B. Taylor.
- Note on Gas Starting of Thermal Bores. *Ibid.* B35:478-80. C. J. Banwell.
- Some Fatigue and Tensile Tests on a Sound and a Defective Weld. *N.Z. Engineering* 9:381-5. P. F. Tomalin.
- Use of Gaseous Discharge as an Identifiable Radar Target. *Nature* 174:367-8. G. W. G. Court.
- Ionospheric Absorption at Vertical and Oblique Incidence. *Proc. I.E.E.* 101: Part III. 360-70. G. McK. Allcock.
- Ionospheric Absorption at Low and Medium Frequencies. *Phys. Soc. Conf. on Physics of Ionosphere*. Sept. 1954. G. McK. Allcock.
- Recommended Methods of Casting Tin Base Bearing Metals. *Inst. Automotive and Aeronautical Engineers* 15:21-3. P. F. Tomalin.
- Electron Microscope Studies of Dentine. *Oral Surg., Oral Med., Oral Path.* 7:662-70. F. R. Shroff, K. I. Williamson, and W. S. Bertaud.
- Proposal for New Aether Drift Experiment. *Nature* 175:350-1. D. D. Crombie.
- Photoelectric Cell Observations of Insects in Flight. *Nature* 175:128-30. I. R. Richards.
- Notes on Sensitive Galvanometers. *N.Z. Elec. Journal* 28:71-3. F. C. Rumsey.
- Stray Currents from Electric Trains in the Hutt Valley. *N.Z. Engineering* 10:38-43. B. A. Meylan.
- The Capacitance of an Anchor Ring. *Aust. J. Applied Physics* 7:347-350. T. S. E. Thomas.
- A Rapid Method for Calibrating Soil Moisture Elements of the Porous Block Type. *Soil Science* 78:333-8. R. L. Closs.

ENTOMOLOGICAL RESEARCH STATION

Director: Dr D. MILLER

MAIN PROJECTS

Grassgrub and *Oxycanus* investigations (exclusive of insect parasites); Manuka blight; insect parasites of grassgrub; collecting, breeding, and distribution of egg parasites of green vegetable bug; importation of parasites of clover case-bearer *Coleophora* spp.; bibliography of New Zealand Entomology; seed-set in red clover with special reference to insect pollination; maintenance and development of insect reference collection; systematic catalogue of Coleoptera of New Zealand; identification service and advice concerning control of insect pests; chemical control of crucifer pests; biological control of crucifer pests; survey and control of insect pests of agricultural crops in Cook Islands, mainly citrus; study of insect material collected on Auckland Islands Expedition; systematic work on sub-family Thynninae (Hymenoptera) and the New Zealand Melolonthinae (Coleoptera); study of plant parasitic nematodes (eelworms); and systematic studies on Aphids and scale insects.

OTHER PROJECTS

Elworm and bacterial parasites of grass grub; control of carpet beetles and pests in stored products; effect of scale insects on southern rata; study on biology and control of slugs in crops and pastures; investigation of *Catoptes* sp., a weevil recorded on crucifers in the cotyledon stage; control of collembola on crucifers; study of apple leaf-curling midge *Dasyneura mali* and its parasites; study of oak leaf-miner *Lithocolletis messaniella* and its parasites; distribution of *Rhyssa* parasites of *Sirex noctilio*; investigation of *Hyperodes griseus* on pasture grasses; cereal pests, particularly army-worms and cut-worms; and investigation into biological control of Mexican Devil Weed (*Eupatorium adenophorum*).

PUBLICATIONS

- The Control of the Meal Mite with Lindane. *N.Z. Ent.* 1 (4):1-3. J. W. Cleland.
- Population Growth in some Introduced Insects in New Zealand. *Proc. N.Z. Ecological Society* (2):10-2. W. Cottier.
- Search for Alternative Vectors of the Yellow-leaf Disease of Phormium. *N.Z. J. Sci. Tech.* A36:32-7. R. A. Cumber.
- Studies on *Oliarus atkinsoni* Myers (Hemiptera : Cixiidae), Vector of the "Yellow-leaf" Disease of *Phormium tenax* Forst.: IV. Disease-vector Relationships. *Ibid.* B35:530-49. R. A. Cumber.
- Injury to Phormium Caused by Insects, Mites, and Molluscs. *Ibid.* A36:60-74. R. A. Cumber.
- The Life-cycle of Humblebees in New Zealand. *Ibid.* B36:95-107. R. A. Cumber.
- Evolutionary Trends in the Thynninae (Hymenoptera : Tiphidae) with Special Reference to Feeding Habits of Australian Species. *Trans. R. ent. Soc. Lond.*, 105:1-10. B. B. Given.
- Melolonthinae (Coleoptera) from the Three Kings Islands. *Rec. Auckland (N.Z.) Inst. Mus.* 4:267-70. B. B. Given.
- The Dryinidae, a Family of Hymenoptera New to New Zealand. *N.Z. Ent.* 1 (4):3-5. E. S. Gourlay.
- Records of Introduced Coleoptera and Notes on the 1953-54 Collecting Season. *N.Z. Ent.* 1 (4):6-10. E. S. Gourlay.
- Notes on the Occurrence of the European Sawfly *Priophorus tener* Zadd. in New Zealand. *N.Z. Ent.* 1 (4):11-2. L. Gurr.
- A Study of the Blackbird (*Turdus merula*) in New Zealand. *Ibid.* 96:225-61. L. Gurr.
- A New Species of *Eriococcus* Targ. (Hemiptera : Coccidae) Attacking *Leptospermum* in New Zealand. *Trans. Roy. Soc. N.Z.* 82 (2):465-74. J. M. Hoy.
- Chlorochiton discoidea* (Broun) Giv. (Scarabaeidae Col.). Final Instar Larva. *N.Z. Ent.* 1 (4):14-5. J. M. Hoy.
- The Biology and Host Range of *Neoplectana leucaniae*, a New Species of Insect Parasite Nematode. *Parasitology*, 44 (3 & 4):392-9. J. M. Hoy.
- Scale Insects Associated with Manuka Species in New Zealand. *N.Z. J. Agric.* 89 (6):601-4. J. M. Hoy.

Manuka Blight—Causative Organism. *Proc. sixth N.Z. Weed Conference*. 38-40. J. M. Hoy.

Usage of Insecticides in New Zealand Agriculture and Horticulture. *N.Z. Science Review* 11 (8):99-101. J. M. Hoy.

A Note on the Death of *Nassella* Tussock (*Nassella Trichotoma* (Nees.) Hack.) due to the Depredations of *Chlorochiton* sp. *N.Z. Ent.* 1 (4): 15-16. A. D. Lowe.

FATS RESEARCH LABORATORY

Director: F. B. SHORLAND

PROJECTS

General Investigations on the Composition of Animal Fats With Special Reference to Those of Meat and Butter.—Isolation and identification of minor constituents: branched-chain fatty acids, unsaturated fatty acids, trans-acids, lower fatty acids, and unsaponifiable constituents. Fatty acid composition: the fats of beef and mutton carcasses, etc., and comparison between the fatty-acid composition of animal fats and those of pasture. Glyceride structure with special reference to butterfat. The use of labelled intermediates to determine the origin of branched-chain fatty acids.

The Role of the Rumen in Modifying the Dietary Fat.—Comparison between the fatty-acid composition of pasture fats and those of rumen contents. The effect of rumen cultures on pure unsaturated fatty acids. Comparisons between the fatty-acid composition of fats of pasture-fed ruminants and those of non-ruminants.

Nutritive Value of Minor Constituents of Animal Fats.—Fatty-acid composition of depot fats of rats fed branched-chain fatty acids (in association with the Nutrition Research Department of the Medical Research Council, Dunedin).

Nature of Meat Phospholipids.—Methods of extraction and purification, development of suitable methods for determining nitrogen, phosphorus, choline, ethanolamine, etc., and fatty-acid composition.

Industrial Utilization of Fats.—Analysis of tall oil with a view to suggesting possible uses. The recovery and utilization of wool grease. The relationship between glyceride structure and physical properties of fats. The relationship between X-ray spacings and melting points of binary mixtures of fatty acids.

Development of Techniques for the Investigation of Fats.—Gas-liquid partition and adsorption chromatography for the resolution of fatty acid mixtures. Method for the estimation of glycerol and monoglycerides.

PUBLICATIONS

Oxidation of Glycerol by Periodate in Alkaline Solution. *J. Chem. Soc.* 4024-5. L. Hartman.

Determination of Fat Peroxides in the Presence of Phospholipids. *J. Sci. Food Agric.* 5:476-80. L. Hartman.

Occurrence of Trans-acids in Animal Fats. *Nature* 174:185. L. Hartman, F. B. Shorland, and I. R. C. McDonald.

- The Branched-chain Fatty Acids of Butterfat: 4. The Isolation of (+)-12-Methyltetradecanoic Acid and of 13-Methyltetradecanoic Acid. *Biochem. J.* 57:297-301. R. P. Hansen, F. B. Shorland, and N. J. Cooke.
- The Branched-chain Fatty Acids of Butterfat: 5. The Isolation of 12-Methyltridecanoic Acid. *Ibid.* 58:358-59. R. P. Hansen, F. B. Shorland, and N. J. Cooke.
- The Occurrence of n-Heptadecanoic Acid (Margaric Acid) in Hydrogenated Mutton Fat. *Ibid.* 58:513-6. R. P. Hansen, F. B. Shorland, and N. J. Cooke.
- Isolation of n-Heptadecanoic Acid from Hydrogenated Mutton Fat. *Nature* 174:39. R. P. Hansen, F. B. Shorland, and N. J. Cooke.
- The Occurrence of n-Pentadecanoic Acid in Hydrogenated Mutton Fat. *Biochem. J.* 58:516-7. R. P. Hansen, F. B. Shorland, and N. J. Cooke.
- Volatile Acids of Ox Perinephric Fat. *Nature* 173:1093. R. P. Hansen, and A. G. McInnes.
- The Occurrence of Dodecanoic Acid in Mutton Fat. *Chem. and Ind.* 1229-30. R. P. Hansen, F. B. Shorland, and N. J. Cooke.
- Occurrence of Fatty Acids with Uneven-numbered Carbon Atoms in Natural Fats. *Nature* 174:603. F. B. Shorland.

FRUIT RESEARCH STATION

Director: Mr J. D. ATKINSON

PROJECTS

Variety Testing.—Recording of long-term blocks of apples, citrus, chinese gooseberries, feijoas, and avocados; and raising promising local seedling peaches.

Rootstock Testing.—Testing selected apple, pear, peach, plum, and citrus rootstocks for growth and yield; and *phytophthora* resistance of apple rootstocks.

Propagation.—Improved methods of raising apricots, peaches, and plums.

Pollination.—Studies on sterility in plums (with Crop Research Division).

Pruning.—Comparison of various systems for peaches and apples.

Citrus Breeding.—Nucellar seedlings as a source of virus-free trees, attempts to produce verrucosis-resistant lemons, and hybrid citrus varieties suited to local conditions.

Fruit Descriptions.—Histories and descriptions of local peaches and plums.

Virus Diseases.—In co-operation with Plant Diseases Division, identification of virus diseases in pip and stone fruit and citrus; effect on yield; and means of securing disease-free trees.

Seed Storage.—Methods of storing citrus and stone-fruit seed.

Plant Hormones.—Six-monthly certification lists, effect of hormones on tomato quality, pre-ripening of stone fruits, parthenocarpic development of frosted apricots, and pre-harvest drop of grapefruit.

Chemical Thinning of Apples.—Effect of timing and concentration of sprays, and reactions of treated fruit in cool store; compatibility of thinning agents with other sprays; effect on biennial bearing; and studies of cell size in treated fruit.

Tree Nutrition.—Diagnosis of deficiency diseases, effect of grassing and contour planting on tree performance, studies on soil and foliar application of fertilizers, and fractionation of nitrogenous compounds in apple and other sap with the object of finding a better test of nitrogen nutrition.

Fruit Storage of Apples.—Methods of scald control, effects of fertilizers on storage quality, reassessment of optimum storage temperatures for major varieties, effects of delay on storage quality, and causes of variation in storage quality.

Fruit Storage of Pears and Plums.—Improving post-storage ripening of pears; and determination of suitable storage temperatures for plums.

Frost.—Testing devices for frost control; and measurement of temperatures dangerous to various fruits.

PUBLICATIONS

Certification of Plant Hormones, 6th List. *Orchardist of N.Z.* 27 (6):29. J. D. Atkinson.

Certification of Plant Hormones, 7th List. *Ibid.* 28 (2):7. J. D. Atkinson. Apple Ring Spot. *N.Z. J. Sci. Tech.* A35:478–82. J. D. Atkinson, E. E. Chamberlain, and J. A. Hunter.

Effect of Thinning Sprays on Storage Quality of Sturmers. *Orchardist of N.Z.* 27 (8):5. R. M. Davison.

The Use of Chemical Thinning Sprays on Apple Trees in New Zealand: I. Preliminary Experiments in Hawke's Bay and Nelson. *N.Z. J. Sci. Tech.* A36:506–15. R. M. Davison.

Hollow End—an Abnormality of Plum Fruits. *Orchardist of N.Z.* 27 (11):2. A. Farmer.

Important Stone Fruit Varieties of New Zealand and Their Origin. *Roy. hort. Soc. Fruit Year Book 1954.* 57–62. A. Farmer.

Omega Plums. Can They Be Exported? *Orchardist of N.Z.* 27 (7):17–9. C. A. S. Padfield.

The Storage of Apples and Pears. *D.S.I.R. Bulletin 111.* 96 pp. C. A. S. Padfield.

Calyx-end Breakdown: an Unusual Form of Breakdown in Sturmer Pippin Apples. *N.Z. J. Sci. Tech.* A36:75–7. C. A. S. Padfield and P. Woon.

Moorpark Mottle: a Virus Disease of Apricots in New Zealand. *Ibid.* A35:471–7. E. E. Chamberlain, J. D. Atkinson, and J. A. Hunter.

Apple Rootstock Trials: I. Sturmer on East Malling Stocks, Northern Spy, and Own Roots. *Ibid.* A35:497–504. C. E. Woodhead, D. W. McKenzie, and A. Farmer.

GEOLOGICAL SURVEY

Director: Dr L. I. GRANGE

REGIONAL PROJECTS

Geological.—The surveys of subdivisions at National Park, Hawke's Bay, North Canterbury, and Southland are being continued, and the Mangakahia Subdivision survey in Northland was completed.

Ground Water.—Work is being continued at Waikato, Hawke's Bay, and Canterbury.

Coal.—The survey of the Waikato Coalfield is being continued, and the Reefton Coalfield survey was completed.

SPECIAL PROJECTS

Sea-floor Sediments.—Work was completed on the sediments and Foraminifera of Cook Strait.

Quaternary Tectonics.—The active faults of New Zealand are being systematically mapped and interpreted in their relation to circum-pacific structure, volcanicity, and earthquakes.

Bibliography.—A bibliography of New Zealand geology has been completed for publication.

Pleistocene History.—Study of Pleistocene life and climate is being continued. During the last year attention was mostly directed to plant fossils.

INDUSTRIAL AND ROUTINE PROJECTS

Limestone.—Deposits were examined for cement making at Otorohanga and Te Kuiti, and for agriculture at Wairarapa, Canterbury, and Southland.

Serpentine and Dunite.—About 59,000 tons of serpentine are used annually to revert superphosphate. Accessible deposits have been reviewed: with the exception of one at North Cape those in the North Island are small, and the largest deposit is at D'Urville Island. A large deposit of dunite at Bluff was surveyed for possible use for fusion with rock phosphate.

Foundation Problems.—Foundations for dams, bridges, and roads in many parts of the country were reported on.

Coal Mines.—Advice was given to mine operators at Kaitangata, Ohai, Reefton, and Waikato.

Geothermal.—Deep drilling has provided much material for study. Rock alteration is being related to steam content and temperature.

PUBLICATIONS

Bibliographic Index of New Zealand Stratigraphic Names. *N.Z. Dep. Sci. Industr. Res. Geol. Mem.* 9. 121 pp. G. L. Adkin.

Late Pleistocene and Recent Faulting in the Otaki-Porirua and Dalefield-Waipoua Districts of South Wellington, North Island, New Zealand. *Trans. Roy. Soc. N.Z.* 81:501–19. G. L. Adkin.

An Extra Volume "Reports Geological Exploration" Series. *N.Z. Sci. Rev.* 12:93–4. G. L. Adkin.

Late Pleistocene and Recent Vertical Movement at the Alpine Fault. *N.Z. J. Sci. Tech.* B35:390–7. F. E. Bowen.

Submarine Geology of Milford Sound, New Zealand. *N.Z. J. Sci. Tech.* B36:397–410. A. F. Brunn, J. W. Brodie, and C. A. Fleming.

A Brief Outline of the Geology of Canterbury. *N.Z. School Science* 4:13–31. B. W. Collins.

Plant Microfossils from New Zealand No. 1. *Trans. Roy. Soc. N.Z.* 81:479–83. R. A. Couper.

Lower Pleistocene Plant Microfossils from the Glenhope Beds and Moutere Gravels, Nelson, New Zealand. *N.Z. J. Sci. Tech.* B36:136–9. R. A. Couper.

Pliocene and Pleistocene Plant Fossils of New Zealand and Their Climatic Interpretation. *N.Z. J. Sci. Tech.* B35:398–420. R. A. Couper and D. R. McQueen.

- Tertiary and Recent Echinoidea of New Zealand: Cidaridae. *N.Z. Geol. Surv. Pal. Bull.* 23. H. B. Fell.
- Notes on the Suter Collection of New Zealand Mollusca—1. *Auck. Mus., Conch. Sect. Bull.* 10:3–4. C. A. Fleming.
- Castlecliffian Fossils from Ohope Beach, Whakatane (N 69). *N.Z. J. Sci. Tech.* B36 (5):511–22. C. A. Fleming.
- Ecology of the Subantarctic Islands: Geological History. *Proc. N.Z. Ecol. Soc.*, 2, *Rep. 3rd Annu. Meeting*:16. C. A. Fleming.
- An Upper Triassic Lamellibranch from the Southern Alps of North Westland, New Zealand (Sheet S 53). *Trans. Roy. Soc. N.Z.* 82 (1):111–14. C. A. Fleming, F. W. Munden, and R. P. Suggate.
- Prospecting for Radioactive Minerals in New Zealand. Govt. Printer, Wellington. 28 pp. L. I. Grange.
- Abstracts of Papers on New Zealand published during 1953. New Zealand Geological Survey. *N.Z. J. Sci. Tech.* B36:411–28.
- Geology of the Upper Owen River Area, Nelson. *N.Z. J. Sci. Tech.* B36:258–67. D. Kear.
- Note on the Kerikeri Basalt (Sheet N 11). *N.Z. J. Sci. Tech.* B35:468–9. A. C. M. Laing.
- Note on Tsunamis Reaching New Zealand. *Ibid.*:470–2. A. C. M. Laing.
- Fossil Leaves, Fruits, and Seeds from the Wanganui Series (Pliocene) of New Zealand. *Trans. Roy. Soc. N.Z.* 82:667–76. D. R. McQueen.
- Upper Palaeozoic Plant Fossils from South Island, New Zealand. *Trans. Roy. Soc. N.Z.* 82:231–6. D. R. McQueen.
- Palaeozoic Plants from New Zealand. *Nature* 173 (4393):88. D. R. McQueen.
- Sediments of Cook Strait. *N.Z. J. Sci. Tech.* B36:14–24. J. J. Reed and A. E. Leopold.
- Geological Reconnaissance of the Retaruke Coalfield, West of National Park. *N.Z. J. Sci. Tech.* B36:268–76. J. C. Schofield.
- Perlite Deposits in New Zealand, Pt. 1, Geology. *N.Z. J. Sci. Tech.* B36:208–18. B. N. Thompson and J. J. Reed.
- Tertiary Mollusca from South-east Wairarapa. *Trans. Roy. Soc. N.Z.* 81:539–55. P. Vella.
- The Geology of Geraldine Subdivision. S 102 Sheet District. *N.Z. Geol. Surv. Bull. n.s.* 50. H. W. Wellman.
- Stress Pattern Controlling Lode Formation and Faulting at Waihi Mine and Notes on the Stress Pattern in the North-western part of the North Island of New Zealand. *N.Z. J. Sci. Tech.* B36:201–6. H. W. Wellman.
- Angle between the Principal Horizontal Stress and Transcurrent Faults. *Geol. Mag.* 91:407–8. H. W. Wellman.
- Pleistocene and Recent Deposits in New Zealand. *Trans. Roy. Soc. N.Z.* 82:909–12. H. W. Wellman.
- A Note on the Geology of Cape Palliser, New Zealand (Sheet N 128). *N.Z. J. Sci. Tech.* B35:440–50. H. W. Wellman and J. W. Brodie.
- Marine Pliocene at Resolution Island, Dusky Sound, Fiordland (S 156). *N.Z. J. Sci. Tech.* B35:378–89. H. W. Wellman (Petrology by J. J. Reed; Paleontology by C. A. Fleming and N. de B. Hornibrook).
- Mineral Resources of the British Commonwealth: Some Recent Developments. *J. Roy. Soc. Arts* 102 (4930):701–24. R. W. Willett.
- Geology of the Catchment of Waimate Stream, South Canterbury, New Zealand. *N.Z. J. Sci. Tech.* B35:14–21. D. D. Wilson.

GEOFYSICS DIVISION

Director: Dr E. I. ROBERTSON

PROJECTS

Apia Observatory.—Continuous recording and analysis of earthquake data; continuous recording and analysis of the geomagnetic field; site testing in connection with the installation of modern seismographs; and installation of modern magnetic instruments.

Magnetic Survey.—Continuous recording and analysis of the geomagnetic field at Amberley; installation of modern magnetic instruments at Amberley; study of secular variation and preparation of magnetic charts for the South-west Pacific area; development of fluxgate magnetometers for use in ionospheric and volcanological research; and magnetic declination surveys of Cook Strait and Foveaux Strait for the Marine Department.

Geophysical Observatory.—Continuous recording and analysis of ionospheric conditions at Christchurch, Rarotonga, and Campbell Island; installation of automatic ionospheric equipment at Rarotonga; construction of fixed frequency ionospheric equipment; the determination of electron distribution with height; recombination and attachment processes in the F2 layer; geomagnetic sudden commencements; lunar tides in the ionosphere; asymmetry in the cosmic ray intensity at Christchurch; and continuous recording and analysis of cosmic ray intensity at Christchurch.

Seismological Observatory.—Continuous recording and analysis of earthquake data; provision of New Zealand time service; crustal structure of the New Zealand region; and study of the seismicity associated with eruptions of Mount Ngauruhoe.

New Zealand Oceanographic Institute.—Hydrology of New Zealand coastal waters; ocean current investigations in the South-west Pacific and New Zealand coastal waters; settlement and growth of ship-fouling organisms; distribution of plankton and shelf faunas in New Zealand coastal waters; morphology and structure of the New Zealand continental shelf; marine geology of Cook Strait; and determination of the direction of travel of ocean waves.

Geophysical Survey.—Geological structure of the Rotorua-Taupo thermal area; fundamental studies of volcanic phenomena; gravity investigations of the major geological structure of the South Island; the geological structure of the principal oil areas of New Zealand; seismic propagation with special application to foundation problems; magnetic and elastic properties of rocks; convergence measurements in coal mines related to safety and economy of mining; development of deep-sea echosounding equipment; and magnetic surveys of Southland Plains and detection of shallow serpentine deposits in North Auckland.

Underwater Research Laboratory.—Research projects for the Royal New Zealand Navy.

PUBLICATIONS

Finding the Direction of Travel of Sea Waves. *Nature* 174:1048. N. F. Barber.

Submarine Geology of Milford Sound, New Zealand. *N.Z. J. Sci. Tech.* B36:397-410. Anton Fr. Bruun, J. W. Brodie, and C. A. Fleming.

The Lunar Diurnal Variation of the Earth's Magnetic Field for All Elements at Amberley, N.Z., Based on Five Years' Observations. *Ibid.* B35:371-7. J. M. Bullen and C. H. Cummack.

The Lunar Diurnal Variation of the Earth's Magnetic Field for All Elements at Amberley, N.Z. *J. Geophys. Res.* 58:554-6. J. M. Bullen and C. H. Cummack.

The Geomagnetic Field in New Zealand at Epoch 1950.5. *D.S.I.R. Geophysical Memoir* 2. 32 pp. A. L. Cullington.

Early Arrivals in Seismic Prospecting. *Nature* 173:1047. F. F. Evison.

Sea Surface Temperature in the South-west Pacific Ocean, from 1949 to 1952. *N.Z. J. Sci. Tech.* B36:285-303. D. M. Garner.

The Permanent Magnetization of Horizontal Volcanic Sheets. *J. Geophys. Res.* 59:223-32. T. Hatherton.

Earthquake Origins in New Zealand During the Year 1953. *Seis. Obs. Bull* S-98. R. C. Hayes.

Electron Distribution in the Ionosphere. *J. Atmos. Terr. Phys.* 5:245-6. G. A. M. King.

Amberley Observatory Magnetic Results for 1951. Government Printer, Wellington.

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Quarterly Seismic Bulletins E124 to E127.

GRASSLANDS DIVISION

Director: Dr J. MELVILLE

PROJECTS

Pasture Establishment.—Oversowing of grasses and clovers in established pastures; pre- and post-emergence use of hormone weedkillers for establishing pastures; nutrient requirement of seedling clovers before and after nodulation; pasture establishment on pumice soils; and methods of clover inoculation.

Pasture Management

Lowland Country.—Effects of frequency and intensity of defoliation on growth of short-rotation ryegrass; effects of time of shutting up on yields of autumn-saved pasture; rates of growth of pasture and the separation of temporary weather effects; persistence of weed seeds under various pasture systems; effects of selective weedkillers and the use of different systems of spray application; effects of phosphate and sulphur on pasture production; interaction of water and nitrogen on pasture growth in summer; the use of sodium bisulphite for silage making; intensive sheep grazing—pilot farmlet trials for fat lamb and wool production; and an intensive dairy farm project (in collaboration with Massey Agricultural College) to study the factors involved in production of high butterfat per acre on a self-contained dairy unit.

Hill Country.—Pre- and post-sowing management for the establishment of oversown clovers and *Lotus*; methods for thickening up sparse clover stands; rotational grazing versus set stocking of hill-country pastures and the provision of winter and summer feed; studies on the differential management of sunny and shady slopes; studies in reseedling of subterranean clover under different managements; buried clover seed in hill-country soils and its ecological implications; fertilizer trials; and growth of pure species under hill-country conditions.

Plant Physiology.—Influence of environment and defoliation on the growth patterns of major pasture species; the influence of different temperature levels on the growth of pasture species in controlled environments; the influence of nitrogen supply and of soil structure additives on the growth of pasture species; the development, testing, and establishment of equipment for measurement of micro-climate data at various centres; anatomical studies of shoot and root growth of various species under different environmental conditions; ion uptake by intact and excised roots of grasses and wheat, including phosphate, sulphate, and ammonium ions; and the effect of "apparent free space" in roots and its significance in the transport of nutrients.

Seed Physiology.—Investigations into the use of tetrazolium staining for the determination of viability of those pasture seeds normally difficult to germinate; the rate of development of seed of subterranean clover; and the effects of various weedkillers on active and dormant weed seeds.

Plant Chemistry.—Animal studies on bloat production and treatment; laboratory studies on extraction and characterization of factors in red clover responsible for stability of foam in the rumen; the soluble constituents of pasture herbage—patterns of synthesis under different environmental conditions and their effect on ruminant metabolism; and the cytoplasmic proteins of pasture species.

Plant Breeding and Genetics.—The maintenance and improvement of bred strains of pasture plants; the selection and breeding of strains of *Lotus* and *Zigzag* clover; the breeding of a new ryegrass with characters between perennial and short rotation; the production and study of polyploids in red clover and *Lotus*; hybridization of *Lolium* and *Festuca* to determine whether the desirable features of each genus can be combined in one plant; the production of a white clover strain that breeds true for an easily identifiable leaf marking; the production genetics of ryegrasses; determination of the optimum number of basic plants for a bred strain of perennial ryegrass; seed production studies in cocksfoot and timothy; and reaction of strains of red clover to photoperiod and experiments on techniques with the aim of improving certification procedures.

Miscellaneous.—Investigations on the goitrogenic factor in white clover.

PUBLICATIONS

Pasture Establishment Studies. *N.Z. J. Sci. Tech.* R. W. Brougham.

Part I. The Effect of Grass Seeding Rate on the Establishment and Development of Pastures of Short-rotation Ryegrass, Red and White Clovers. *A35:518–38.*

Part II. The Influence of Herbage Height at Grazing, and of Grass Seeding Rate, on the Establishment and Development of Pastures of Short-rotation Ryegrass, Red and White Clovers. *A35:539–49.*

Part III. Barley as a Cover Crop in Establishing Pastures for the Production of Late Autumn and Winter Green-feed. *A36:47–59.*

Part IV. A Comparison of Mixtures Containing Short-rotation Ryegrass, Perennial Ryegrass, or Both, as the Grass Component. *A36:365–74.*

- Bloat in Cattle on Red Clover: I. *Ibid.* A36:289–320. A. T. Johns.
- Growth of Pasture Species: I. Short-rotation and Perennial Ryegrass. *Ibid.* A36:193–206. K. J. Mitchell.
- Effects of Soil Acidity on the Growth of Pasture Plants: II. A Field Trial with White Clover (*Trifolium repens*). *Ibid.* A36:167–76. A. J. McNeur.
- Preliminary Note on the Extraction of a Bloat-promoting Fraction from Red Clover. *Ibid.* A36:285–6. R. P. Newbold.
- Pasture Management Trials on Unploughable Hill Country: I. Establishment of Experimental Area and Results for 1949–51. *Ibid.* A36:237–73. F. E. T. Suckling.
- Numbers and Weights of Earthworms Under a Highly Productive Pasture. *Ibid.* A36:516–25. R. A. S. Waters.
- The Relation Between Modulator and Activator in Maize. *Proc. Nat. Acad. Sci. U.S.A.* 40 (12):1118–26 (1954). P. C. Barclay, and R. A. Brink (University of Wisconsin).
- A New Cocksfoot. *N.Z. J. Agric.* 89:481–2. L. Corkill.
- Improvement of Hill Country Pastures by Oversowing. *Ibid.* 88:541–3. F. E. T. Suckling and G. S. Harris.
- Antihistaminics and Adrenalin in the Treatment of Bloat. *N.Z. Vet. J.* 2:98. A. T. Johns and C. S. W. Reid.
- Antithrombin Activity of Heparin. *Biochem. J.* 58:16–23. J. W. Lyttelton.
- Antithrombic Activity of Human Plasma. *Ibid.* 58:8–15. J. W. Lyttelton.
- Hill Pasture Improvement. *Abraham Seed Co., Palm. Nth.* 1954. 24 pp. F. E. T. Suckling.
- Results of Pasture Establishment Trials. *Proc. 15th Conf. N.Z. Grassl. Ass.* pp. 141–50. P. D. Sears.
- Strains of Strawberry Clover. *Ibid.* pp. 151–6. L. W. Gorman.
- Pasture Measurement Techniques as Applied to Strain Testing. *Ibid.* pp. 157–65. A. J. McNeur.
- Short-rotation Ryegrass. *Ibid.* pp. 176–88. L. Corkill.
- The Future of Grassland Research in New Zealand. *Proc. 14th Conf. N.Z. Soc. Anim. Prod.* pp. 52–9. J. Melville.
- Production Per Acre Trial at Massey Agricultural College: Progress Report B—General Account of Management Practices. *Proc. 7th Ann. Mtg. Dairyfrms.*, Massey Agric. Coll. pp. 23–8. A. Stewart (Massey Agric. Coll.) and E. O. C. Hyde.
- Pasture Establishment. *Ibid.* pp. 29–34. R. W. Brougham.
- Progress Report on Bloat Research. *Ibid.* pp. 75–82. A. T. Johns.
- The “Acid Theory” and Correction of Over Acidity. *Rept. Proc. N.Z. Greenkeepers Conf.* 1954. pp. 5–12. G. S. Harris.
- Quantitative Methods of Evaluating Weedicides Applied to Pasture. *Proc. 7th N.Z. Weed Control Conf.* pp. 16–21. D. Edmond.

HOP RESEARCH

Station Research Officer: Dr R. H. J. ROBORGH

PROJECTS

Breeding.—The study of botanical characters to aid differentiation of hop varieties; the introduction and evaluation of hop varieties from overseas; the breeding of new hop varieties resistant to root rot (*Phytophthora* spec.); the germination of hop seed; the technique of testing for susceptibility to root rot at the seedling stage; the technique of rapid propagation of promising seedlings; and the raising of polyploids.

Agricultural Operations.—Wiring the hop garden at different heights; spacing of hop hills; cultivation and covercropping on the different soil types; manuring, particularly as regards influence on the occurrence of root rot; pruning at different times throughout the year; the evaluation of different stringing methods; training different types of vines; picking by hand with and without cutting the vines; and drying conditions.

INFORMATION BUREAU

Officer in Charge: Mr N. A. MARRIS

PROJECTS

The Information Bureau provides certain special services for the Department, its branches, and others. The work of the Bureau includes the editing and publishing of the *New Zealand Journal of Science and Technology* and other departmental publications, the provision of central library services (inter-library lending, book ordering, and reference facilities), a technical information section, a public relations and publicity section, a translation section, a photographic section, a photo-copy service, and (for staff information) the issuing each month of the *D.S.I.R. Newsletter*.

PUBLICATIONS

Apart from the *Journal*, and some twenty bulletins and other major publications handled on behalf of branches, the Information Bureau has edited and published the following: the annual report, Dairy Farm Survey of Waipa County 1940–41 to 1949–50, and Departmental Handbook (2nd Edition).

PLANT DISEASES DIVISION

Director: Dr G. H. CUNNINGHAM

PROJECTS

Entomology

Life history and field ecology studies of carrot rust fly; studies on therapeutant control and varietal resistance of chrysanthemum gall midge; life history studies on the two important citrus thrips; studies of the effect of crystal size of insecticides on their toxicity; survey of stored products pests in New Zealand, and studies of effectiveness of methyl bromide fumigation; survey to ascertain which species of leaf rollers are of importance in New Zealand; taxonomic studies on *Lepidoptera*, *Diptera*, and *Trichoptera*, and on stored-products pests (moths and spider beetles).

Economic Mycology

Cereal diseases: wheat—mildew (race survey and progeny testing for resistance), speckled leaf-blotch (effect on yield, varietal resistance), and cereal yellow dwarf (symptoms, host range, vectors, incidence, effect on yield and resistance testing). Oats—crown rust (race survey and progeny testing for resistance).

Linseed diseases: flax rust (race survey and progeny testing for resistance).

Swede diseases: dry rot—progeny testing for resistance; relationship between date of inoculation and severity of infection (with Crop Research Division); and therapeutant trials (with Department of Agriculture). Club root—progeny testing and varietal resistance; and therapeutant trials.

Potato diseases: pink rot (soil isolation, therapeutant trials, varietal resistance); and late blight (isolation and culture of races for resistant trials).

Pea diseases: root rot (varietal resistance); and pea wilt (progeny testing for resistance).

Lucerne diseases: two new diseases—root rot (symptoms, pathogenicity, incidence); and crown wart (symptoms, pathogenicity, incidence).

Ryegrass leaf rust: selection of differential strains of ryegrass species for pathogenicity testing and determination of physiological races; strain reaction and host range studies; and effect of leaf rust on animal thrift (with Department of Agriculture).

Onions: white rot—therapeutant trials, varietal resistance, and progeny testing for resistance.

Botrytis rot on tomatoes: evaluation of therapeutants mixed with fruit-setting hormones for control of botrytis rot (with Fruit Research Station); and studies on saprophytic fungi in the control of botrytis rot on plants sprayed with hormone sprays.

Leaf mould on tomatoes: testing of new varieties developed overseas for resistance to leaf mould.

Fruit-tree diseases: apple collar rot (studies on varietal resistance in rootstocks; development of technique for isolation of causal organism from orchard soils); silver leaf (studies on control with systemic fungicides); pythium disease of pears (incidence, pathogenicity, and effect on orchard production); and moulds on exported passion fruit after arrival in England (investigation of control by therapeutant treatment before packing for export).

Verticillium wilt: host range studies; and development of inoculation technique to test progeny reaction in hop and tobacco breeding projects.

Bean rust: testing material for disease resistance (co-operative project with Crop Research Division).

Cypress canker: studies on causal organisms, strain pathogenicity, seedling susceptibility variations, and resistance between species.

Death of pines: studies on mortality of *Pinus radiata* in Auckland district; pathogenicity of *Phytophthora* species isolated from soil or root zones of affected trees; and standardization of technique for isolation of *Phytophthora* species from soil.

Disease surveys: wheat diseases in Canterbury (co-operative project with Crop Research Division); leaf and stem rust of grasses in New Zealand pastures; and crown rust of oats in Marlborough, Canterbury, and Southland.

Seed pathology: study of zero tolerance levels of infection in relation to collar rot of peas; survey of annual incidence of seed-borne disease in peas in relation to crop health; and study of seed maturity and moisture content in relation to efficacy of thermo-chemical treatments for disease control.

Soil microbiology: associated growth of soil micro-organisms in culture; effect of soil organisms or parasitic soil fungi; and survey of *Phytophthora* spp. in soils.

Host-parasite relationships: study of biochemistry in plant-disease development in relation to varietal resistance; biochemistry of host plants; and nutrition of pathogenic fungi.

Control of black pod and other diseases of Cacao in Western Samoa (for Department of Island Territories): investigation of the control of black pod in particular and Cacao diseases in general in Western Samoa.

New diseases: identification and recording of new fungous diseases and additional host plants.

Industrial mycology: general investigation and control of mould fungi in industry, particularly on cork, composition materials, naval equipment, clothing, and stores.

Systematic Mycology

Collection and identification of New Zealand fungi for herbarium; preparation of monographs of genera of *Thelephoraceae*, *Corticium*, *Vararia*, *Asterostroma*, *Peniophora*, and *Lophtharia*; revision of New Zealand species of *Hypocreaceae*; life history studies in the genera *Hypomyces*, *Hypocrea*, *Nectria*, and *Gibberella*; and description of further species of *Uredinales* recorded in New Zealand.

Bacteriology and Microbiology

Blast of stone fruit: studies on systematics of the causal organism; determination of host range; studies on variations of pathogenicity amongst strains; factors favouring infection, particularly temperature; effect of defoliation chemicals on susceptibility of nursery trees to infection; efficacy of pruning on control in the field; efficacy of streptomycin dips for control of the disease in budwood; and field trials to determine efficacy of streptomycin, agrimycin, and other therapeutants.

Investigation of streptomycin formulations for control of blast of stone fruit: spray formulations—effectiveness of different formulations against causal organism *in vitro*; effectiveness of different formulations in preventing development of the disease on peaches under experimental conditions; phytotoxicity of different formulations to fruit tree hosts; and compatibility of different formulations with selected fungicides and insecticides. Wound dressing formulation—a formulation developed for application to wounds and cankers is under test.

Halo blight of bean: comparison of Streptospray and Bordeaux mixture for control of halo blight.

Bacterial spot of plum and peach: investigations on control by use of resistant stocks and by therapeutant sprays.

Fireblight: glasshouse infection studies.

Diagnosis of plant bacterial diseases.

Clover nodule bacteria: behaviour of strains of clover nodule organisms on different clovers, media, and soils and in different localities of undeveloped country; selection of efficient strains for red, white, and subterranean clovers; methods of inoculating legume seed and methods of sowing it; investigation of viability of nodule organisms in carriers such as peat; establishment of clover culture supply service for farmers; effect of minor elements on efficacy of nodule bacteria; establishment of lucerne on pumice soils; investigation of suitable method for certification of legume cultures; and supply of cultures for lucerne inoculation.

Studies on *Streptomyces*: morphological and physiological studies of the genus; use of the electron microscope to ascertain details of its morphology and development; utilization of carbohydrates as an aid to classification; and study of the *Streptomyces* present in New Zealand soils with special reference to the systematics of the group.

Uptake and translocation of streptomycin by the roots of peach seedlings: quantitative determination of streptomycin following absorption; rate of absorption under controlled conditions of temperature and humidity; stability of the compound following absorption; toxicity of the compound to peach seedlings following root absorption; control of blast of stone fruit following absorption; and identification of streptomycin in peach tissue.

Factors governing absorption of streptomycin following foliar application: tests of ability of several formulations to be absorbed, and of absorption with different techniques of application; studies on effect of climate and state of plant growth on absorption; studies on variations in absorptive capacity of different plant species; and development of technique for detecting trace quantities of streptomycin in plant tissues.

Investigation of the antifungal antibiotic griseofulvum: selection of suitable fungous pathogens.

Investigations to determine whether fungi associated with Manuka blight are antagonistic to manuka.

Virus Diseases

Legume viruses: survey of legume virus diseases in pastures in Manawatu, Hawke's Bay, and Marlborough; inheritance of immunity to pea mosaic in peas (co-operative project with Crop Research Division); and survey of virus diseases of peas in Marlborough.

The use of tissue culture techniques for testing the effect of various chemicals on the multiplication of viruses in potato plants.

Effect of organic acids, growth substances, and antibiotics on plant virus multiplication.

Hop virus diseases: testing the variety Petham Golding as an indicator for hop virus diseases in New Zealand.

Grey wall and blotchy ripening of tomato: studies of effect of soil moisture and fertilizers on development of the disease.

Chemotherapy of viruses: studies on the effect of substituted purines and other compounds on virus multiplication.

Studies on the constitution of virus nucleoprotein.

Fruit-tree viruses (in collaboration with Fruit Research Station): apple mosaic—effect on tree growth and fruit yield, studies on strains present in New Zealand, and cross protection studies; apple green crinkle (varietal range studies); apple ring spot (transmission and varietal range studies); and pear stony pit (varietal range studies). Plum mosaic—effect on tree growth and fruit yield, and effect of infection on scion-stock compatibility; identification of stone fruit virus diseases; studies on the effect of heat treatment of growing trees as a means of eliminating viruses from infected trees; production of virus-free nursery trees by roguing infected stocks and selection of healthy budwood trees; and (with Department of Agriculture) eradication of certain fruit-tree virus diseases of low incidence.

Virus diseases of roses: studies on incidence, identification, and transmission.

Plant Therapeutants

Therapeutant certification: issue of revised Certification Lists twice yearly, investigations into complaints about certified products, checking quality of certified products, and examination and classification of products newly submitted.

Efficacy of plant therapeutants: glasshouse screening tests and field trials with spray materials of test organisms (late blight on tomato and potato, grey mould on tomato and lettuce, rust on dwarf, runner, and broad beans, black spot on apple, pear, and rose, *Fabraea* scald on quince, leaf spot on celery, leaf mould on tomato, powdery mildew on apple and tree tomato, halo blight on bean, ring spot on lettuce, red mite on apple, pear, and dwarf bean, codling moth on apple, mealy bug on grape and pear, thrips on citrus, leaf roller on apple, leaf hopper on apple, woolly aphis on apple, caterpillars on tomato and bean, aphids on swede, and rose and clover mite on dianthus); glasshouse and field trials with seed dusts of test organisms (damping off of lucerne and onion); and glasshouse and field trials with soil disinfectants of test organisms (verticillium wilt on tomato and club root on brassicas).

Therapeutant control of particular diseases: ripe spot on Sturmer apples, brown rot of peaches, white rot of onions, damping off of pine seed, carrot rust fly, and eelworm and fungous diseases of gladiolus.

Control of seed borne diseases: effect of fungicides on emergence of peas, beans, lettuces, onions, wheat, barley, and oats; effect of insecticides on seed germination; and effects of seed treatments on viability of seeds in storage.

Phytotoxicity of plant therapeutants: mercury damage to apple buds; and phytotoxicity of sprays on apples.

Toxic residues on fruit and vegetables following spray treatments (in collaboration with Dominion Laboratory).

Compatibility of therapeutants used in spray mixtures.

Orchard spray programmes: comparative trials with various spray programmes on apples.

Miscellaneous investigations: comparison of various copper oxychloride formulations in control of late blight of tomatoes; resistance of copper sprays to weathering; and tainting of vegetables from B.H.C. applications.

Horticulture

Silver leaf on peach: studies on effect of summer and winter pruning on incidence.

Chrysanthemum eelworm: effect of modifications of hot-water treatment as efficacy of control; and efficacy of hot-water treatment followed by intensive spray programme.

Soil disinfection with electric sterilizers: studies on additives to influence soil conductivity.

Aerial layering: tests with this method to secure rooting in plants which will not produce roots by other methods.

Weed control: studies on control of oxalis and twitch.

Timber Preservation

Preservation of plywood against borer attack: studies on effectiveness of preservatives added to glue.

Control of borer infestations: studies on effectiveness of B.H.C. smokes.

Diffusion treatment of timber with boron compounds for control of borer: determination of concentration and time required to give adequate preservation.

Death of pine trees: studies on sap flow as means of detecting when death occurs.

PUBLICATIONS

Note on Tutsan Rust in New Zealand. *N.Z. J. Sci. Tech.* A36:483-4. Shirley D. Baker.

French-bean Rust (*Uromyces appendiculatus*) in New Zealand. *Ibid.* A36:280-4. R. M. Brien and H. Jacks.

Turf Diseases. *N.Z. Greenkeepers' Assoc. An. Report 1953.* 47-9. R. M. Brien.

Plant Virus Diseases in New Zealand. *Bulletin No. 108 D.S.I.R.* 255 pp. E. E. Chamberlain.

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Use of Antibiotics in Control of Stone Fruit Blast (*Pseudomonas syringae* van Hall). *Ibid.*:83-5. E. E. Chamberlain.

Virus Diseases of Pip and Stone Fruit Trees in New Zealand. *Ibid.*:126-32. E. E. Chamberlain.

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Internal Seed-borne Diseases—a Note on their Control. *Report 5th Commonwealth Mycological Conference 1954.* 26-27. I. A. M. Cruickshank.

Thermo-chemical Seed Treatment. *Nature* 173:217-18. I. A. M. Cruickshank.

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- Blast of Stone Fruit and its Control. *Orchardist of N.Z.* 27 (10):13, 15, 17. D. W. Dye and M. H. Dye.
- Effectiveness of Therapeutants Including Antibiotics in Preventing Development of Blast of Stone Fruit (*Pseudomonas syringae* van Hall). *N.Z. J. Sci. Tech.* A36:21-6. D. W. Dye and M. H. Dye.
- In vitro* Studies of the Effect of Antibiotics on *Pseudomonas syringae*. *Ibid.* A36:27-31. M. H. Dye.
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- Some Notes on and Additions to the Drosophilidae (*Diptera*) of Samoa and Fiji. *Trans. Roy. ent. Soc. London* 105:97-116. R. A. Harrison.
- A Study of the Momentary Immersion Method for Diffusion Treatment of *Pinus radiata* with Boron Compounds. *N.Z. J. Sci. Tech.* B36:56-81. K. M. Harrow.
- Successful Adaptation to Commercial Practice of Momentary Immersion Treatment with Boron. *N.Z. Timb. For. Rev.* 1 (6):19, 26. K. M. Harrow.
- Toxicity of Boliden Salt BIS-S, Copper Sulphate, and Celcure to the Common House-borer, *Anobium punctatum* de Geer. *N.Z. J. Sci. Tech.* B36:277-80. K. M. Harrow.
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- Plant Therapeutants Under Test. *Orchardist of N.Z.* 28 (1):7, 9. H. Jacks.
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- Screening Tests with Insecticides for Control of Red Spider Mite (*Tetranychus urticae* Koch) on Beans. *Ibid.* A36:454-9. H. Jacks.
- Seed Disinfection 10. Effect of Seed Protectants on Emergence of Spinach. *Ibid.* A36:129-33. H. Jacks.
- Seed Disinfection Practices. *N.Z. Com. Gard. J.* 9 (11):3, 5, 7, 12. 9 (12):10. H. Jacks.
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- Control of Fabraea Scald of Quinces. *Orchardist of N.Z.* 27 (8):3, 5. H. Jacks and P. J. Brook.
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- Effects of Some Purine Analogues on Tobacco Mosaic Virus. *J. gen. Microbiol.* 10:521-32. R. E. F. Matthews.
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- Records and Observations of New Zealand Lepidoptera. *N.Z. Entomologist* 1:27-30. K. A. J. Wise.
- Two Cases of Synonymy in the Nomenclature of Lepidoptera. *Ibid.* 1:31-2. K. A. J. Wise.
- Pests of Stored Products in New Zealand: I. Family Phycitidae (Lepidoptera). *N.Z. J. Sci. Tech.* B36:523-30. K. A. J. Wise.
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- A Report on Cypress Canker in New Zealand. *N.Z. J. Agric.* 88:211, 213, 215, 217, 219-20. C. E. K. Fuller and F. J. Newhook.

SCIENTIFIC LIAISON SERVICE

Officer in Charge: Mr N. A. MARRIS

ACTIVITIES AND PROJECTS

London.—The Scientific Liaison Officer has represented New Zealand on a number of Commonwealth scientific committees, including the Executive Council of the Commonwealth Agricultural Bureaux, and has also attended meetings of the Commonwealth Advisory Committee on Defence Science, the Commonwealth Advisory Aeronautical Research Committee, and the Commonwealth Council of Oceanography. In addition, the Liaison Officer has given oversight to holders of New Zealand National Research Fellowships and to officers of the Defence Science Corps who are undertaking research or training in the United Kingdom. Further activities have included the forwarding of radio-active isotopes for medical and research work to New Zealand; attendance at special conferences, e.g., Oil Pollution of the Sea, and Safety in Mines; and investigations relating to new fertilizers, geothermal resources, dehydrated meat, the grassing down of orchards and hop gardens, the use of hormones for the thinning and ripening of apples, and improved techniques in the use of chromatography and ion exchange for analytical purposes.

Washington.—The activities of the office have increased in range during the year. In addition to forwarding scientific information, technical publications, etc., and giving assistance to scientific visitors from New Zealand, more special inquiries have related to smelting of ilmenite, pesticides, air pollution control, special cements, fertilizers, food research, thermo-regulators, plastics, and isotopes.

SOIL BUREAU

Director: Mr N. H. TAYLOR

PROJECTS

Agricultural

Soil Surveys.—North Island: Gisborne Flats (20 ch./in.), Taupo district (40 ch./in.), and sand country, Manawatu, Part 2 (40 ch./in.).

South Island: plains and downlands of Canterbury and North Otago (2 m./in.), Incheclutha (40 ch./in.), South Island (4 m./in.), fruit-growing areas of Central Otago (40 ch./in.), Geraldine County (40 ch./in.), Heathcote County (40 ch./in.), and Ida Valley (40 ch./in.).

Fiji: the soils of Vanua Levu (2 m./in.).

Special Investigations.—Survey of inorganic soil colloids in New Zealand soils; base exchange mechanism of allophane clays; radioactivity of some New Zealand soils; composition of soil solutions of main soil types; survey of available minerals in soils extracted by sweet vernal; survey of available copper in New Zealand soils; the potassium-supplying power of soils; forms of phosphate in Haast-Alexandra soils; forms of phosphorus in New Plymouth black loam—residual effect of phosphate topdressing; zonal peats of the Lord Auckland Islands; soil changes following burning of scrub; earthworm survey of New Zealand soils; biological investigation of tussock grassland soils; reconnaissance of tussock grasslands in North Island; aggregation of sandy soils by mycelium; pF curves of Taupo pumice soils; specific gravity properties of clay soils; moisture properties of four important soil types in Whangarei County; and laboratory testing of drainage-promoting chemicals.

Forestry

Soils of the northern part Kaingaroa Forest (40 ch./in.), soils of the northern part Te Wera State Forest (40 ch./in.), chemical investigation of litter and humus of red beech, rate of podzolization under *Pinus radiata* on pumice soils, vegetation survey of Taita catchment, and soil fertility problems in the Golden Downs State Forest.

Engineering

Field tests of underground corrosion; underground corrosion of asbestos cement pipes; compilation of basic soil mechanics data from test sites; physical properties of New Zealand estuarine soils—comparison of 20-minute and 24-hour loading cycles, Ava Bridge foundation, and Opuā Harbour development; technique of methods of measuring changes in the pressure of water contained in soil pores; and triaxial tests on sands.

PUBLICATIONS

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- The Solubilization of Insoluble Phosphates: II. A Quantitative and Comparative Study of the Action of Chosen Aliphatic Acids on Tricalcium Phosphate. *N.Z. J. Sci. Tech.* B36:49–55. H. W. Johnston.
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- A Simple Controllable Air Leak for a Vacuum Flask. *Ibid.* B36:207. D. C. McDonald.
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Some Observations on the Ciliate Fauna of an Experimental Meat Digestion Plant. *Trans. Roy. Soc. N.Z.* 82 Pt. 1:199–211. J. D. Stout.

Effect of Environmental Factors on the Life History of the Ciliate *Vorticella microstoma*. *Trans. Roy. Soc. N.Z.* 82 Pt. 3:705–11. J. D. Stout.

The Role of Soil Science in New Zealand Problems. *Trans. Roy. Soc. N.Z.* 82:961–72. N. H. Taylor.

TOBACCO RESEARCH

Station Director: Mr R. THOMSON

PROJECTS

Seedling Bed Work

Alternatives to steam sterilization for the control of weeds and disease; rate of seeding and methods of sowing; incorporating fungicides and insecticides in the soil prior to sowing; and seed treatments for the control of disease.

The Crop in the Field

Fertilizers.—Optimum use of phosphate and potash, with and without magnesium; response of tobacco to minor elements—copper, zinc, manganese, and molybdenum; application of fertilizers—most suitable time to apply nitrogen; effect of boron on yield and quality of different varieties; and demonstration plots to illustrate various deficiencies.

Cultural.—Effect of spacing on size of leaf and total yield; rotation and cover crops—spelling the land for one season with a variety of cover crops; and irrigation experiments—studies of the moisture requirements of the tobacco crop.

Plant Breeding.—Resistance to Black Root-rot, Mosaic, Verticillium Wilt, and Phytophthora Canker; and breeding for improved quality, and inheritance studies.

Variety Trials.—Locally developed lines and imported varieties from Canada and the United States of America.

Seed Production.—Maintaining a supply of seed for the industry, and building up a reserve.

Kilns and Curing.—Fundamental work on curing in cabinets under controlled conditions; and kiln design (in co-operation with Dominion Laboratory).

PUBLICATION

Raising Tobacco Plants from Seed. *N.Z. J. Agric.* 89:489–96. R. Thomson.

WHEAT RESEARCH INSTITUTE

Director: Mr E. W. HULLETT

PROJECTS

Services.—Determination of the milling and baking quality of new wheats produced at the Crop Research Division. Testing service for millers and bakers and the Wheat Committee. Advisory service for farmers, millers, and bakers (who make the most use of the service) and other flour users; this covers drying and storage of grain, milling and baking technology, and involves visits to many bakeries and mills. Training courses in baking for apprentices (in co-operation with the Education Department and the Commissioner of Apprenticeship).

Other Projects.—Biochemical study of oxidation in doughs, establishment of new standards for grading wheats and flours, further development in experimental baking facilities, measurement of optimum humidity and temperature in ovens, study of the factors determining final proof rate of doughs, investigation and advisory work for the purpose of encouraging the use of New Zealand milk powder overseas, practical testing of calculators and techniques designed to facilitate the planning of work in mechanized bakeries, and further work on any of a number of practical problems that can be studied only when particular conditions occur.

PUBLICATIONS

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Bread Making Ingredients. *Ibid.* (May 1954).

Heat Quantity and Intensity. *Ibid.* (June 1954).

Enzymes in Breadmaking. *Ibid.* (July 1954).

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Latent Heat. *Ibid.* (Sept. 1954).

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INCORPORATED RESEARCH ASSOCIATIONS

THE DAIRY RESEARCH INSTITUTE (N.Z.)

Director: Professor W. RIDDET

The financial year of the Institute ends on 31 July next, after which a separate report will be issued. The investigations under way include studies on the following subjects:

Cheesemaking.—Large-scale trials on the relationship of cheese-storage conditions to incidence of discoloration in Cheddar cheese, as part of a wider investigation of the process of ripening of Cheddar cheese; maintenance of single-strain starter cultures in active condition and search for new phage-resistant strains; manufacture and ripening of Gruyère cheese from New Zealand milk; and improvement in air-conditioning plants for cheese-factory curing-rooms.

Buttermaking.—Causes of development of storage flavour in butter during long-period frozen storage; effects of variation in pH of butter, within a narrow range, on the keeping quality; relation of temperature of separation of cream from milk to quality and keeping quality of butter; charting of seasonal changes in characteristics of New Zealand butterfat over a period of years; and design of equipment for deodorization of cream to give maximum economy in the use of steam.

Casein.—Methods of measurement and survey of viscosity of solutions of commercial casein.

Dairy Engineering.—Apart from work included under the above headings, ways and means of effecting economies and improving efficiency in the use of steam; and analysis of applicability of refrigerating systems available for building up ice banks to supply chilled water for farm milk coolers.

Dairy Husbandry.—Effect of underfeeding of cows at various periods, and especially in the period immediately after calving, on the yield and composition of milk; effect of plane of nutrition on the characteristics of butterfat; use of milk powders for the feeding of calves; and lactational changes in the composition of milk.

PUBLICATIONS

Amino-acids in New Zealand Cheddar Cheese: Their Possible Contribution to Flavour. *J. Sci. Food Agric.* 12:604. J. C. Dacre.

The Cooling Efficiencies and Water Pressures of Some Surface Milk Coolers for Farms. *J. Dairy Res.* 20:280. J. K. Scott.

The Transfer of Heat in Surface Milk Coolers for Farms. *Dairy Industries* 18:772. J. K. Scott.

A Method of Investigation of the Steam Distillation of Cream for Removal of Taint. *Proc. 13th Int. Dairy Congr.* 781. F. H. McDowall.

Heat Economy in New Zealand Butter Factories. *Proc. 13th Int. Dairy Congr.* 923. J. K. Scott.

Mechanization of Cheese Manufacture in New Zealand. *Ibid.* 816. J. K. Scott and H. R. Whitehead.

Various Symptoms of Bacteriophage Action in Cheddar Cheese Manufacture. *Ibid.* 1102. H. R. Whitehead.

A Device for Rapidly Churning Small Quantities of Cream. *J. Dairy Res.* 21:78. R. M. Dolby.

Growth Characteristics of Streptococcal Phages in Relation to Cheese Manufacture. *J. Dairy Sci.* 37:209. V. L. Zehren and H. R. Whitehead.

Recent Dairy Research Work in New Zealand. *Dairy Sci. Abstr.* 15:669. I. L. Campbell and R. M. Dolby.

The Effect of Temperature Treatment of Cream Before Churning on the Consistency of Butter. *J. Dairy Res.* 21:67. R. M. Dolby.

Quality and Keeping Quality of Non-washed Butter. *N.Z. J. Sci. Tech.* 35:175-88. F. H. McDowall, J. A. Singleton, and J. J. O'Dea.

Moisture Losses in Cheddar Cheese Undergoing Curing. *J. Dairy Res.* 21:212. J. K. Scott.

Direct Effects of Climate on Cattle. I—Some Observations on the Skin Temperature, Body Temperature, Respiration Rate, and Pulse Rate of Dairy Stock Under Normal Temperature Conditions. *N.Z. J. Sci. Tech.* 36:1-9. II—Measurements of Skin Temperature in Cattle. *Ibid.* 36:10-4. III—The Diurnal Trend in Body Temperature, Respiration Rate, and Pulse Rate. *Ibid.* 36:93-102. M. R. Patchell.

Some Recent Developments and Researches in Dairy Practice and Technology. *Aust. J. Dairy Tech.* 9:61. F. H. McDowall.

THE NEW ZEALAND FERTILISER MANUFACTURERS' RESEARCH ASSOCIATION (INC.)

Director: Dr B. W. DOAK

PROJECTS

Long term effect of various phosphatic fertilizers on the chemical composition of the soil.

The effect of fineness of grinding on the phosphate availability in fused calcium magnesium phosphates: in the first nine months, using 3 cwt. per acre, the coarse (as quenched) product gave a 6 per cent increase in yield over control, compared with 16 per cent from finely-ground material (73 per cent passing 120 mesh).

Granule size in relation to the efficiency of granulated super for top-dressing of pastures (commercial super given rating of 100): no phosphate 83; $\frac{1}{16}$ to $\frac{1}{8}$, 99.7; $\frac{1}{8}$ to $\frac{3}{16}$, 103; $\frac{3}{16}$ to $\frac{1}{4}$, 98.3.

Part played by calcium sulphate in superphosphate: the sulphate ion promotes the fixation of phosphate into a water-insoluble form but appears to delay its conversion to a more insoluble state.

Investigation into the use of slowly soluble cobalt compounds, including frits, in an endeavour to overcome cobalt unavailability in heavily limed soils.

Sulphur in soils, loss from soil, amounts added in rainwater, conversion of inorganic sulphur into organic sulphur.

THE NEW ZEALAND LEATHER AND SHOE RESEARCH ASSOCIATION (INC.)

Director: Mr F. W. WOODROFFE

PROJECTS

The use of low alkali depilatory paints.

The modified pickling process with the use of B. Naphthol.

The control of hard spot on wet salted calf skins.

The use of phosphate glass 696 as a pretannage.

Hot pitting of sole leather.

The reaction of (a) Mimosa, and (b) Myrobs on chromed hide powder where the SO_4 is completely replaced by organic acid radicles, phosphate, and an acid dye radicle.

The effect of retannage on colour using chrome at five levels, and retannage at pH 3, 4, 5, and 6.

Flexible sole retan at various chrome contents.

The study of the effect of retanning with purified tans on the sulphate anions.

PUBLICATION

The Deterioration of Pickled Pelts. *J. Soc. Leather Trades' Chemists* 38:399-418. F. W. Woodroffe and F. G. Caughley.

THE NEW ZEALAND POTTERY AND CERAMICS RESEARCH ASSOCIATION (INC.)

Chief Executive Officer: Mr I. C. McDOWALL

PROJECTS

Properties of clays in the Winton area of Southland. Masonry mortars. Raw materials used in Invercargill. Some works experiments in the production of bricks and sewer pipes with the use of the PACRA Pulverizer. The principles, design, and construction of down-draught kilns. The raw materials used in Ashburton. The fixing of floor and wall tiles. The clay resources of the South Auckland area. Some tests upon bricks manufactured in New Zealand. The testing of materials. The use of boron compounds in salt-glazing.

PUBLICATION

Structural Failures of Floor and Wall Tiles: a Review. *N.Z. Engineering* 10:45-53. V. A. Youl and W. Vose.

NEW ZEALAND WOOLLEN MILLS' RESEARCH ASSOCIATION (INC.)

Director: Dr L. F. STORY

PROJECTS

Pre-lamb-shorn Wool.—Part of the 1954 wool is to be processed, and in the 1955 season two clips of Corriedale wool from the same flock will also be available for study.

Carding Surveys.—It is hoped to extend these to some of the other mills.

Ring-spinning.—Work is continuing and it is hoped to extend it to different counts of yarn and wool qualities.

Causes of Tenderness, Break, and Canary Stain.—It is hoped shortly to initiate work on these faults which are rather common in New Zealand wools.

PUBLICATIONS

Some Factual Data on Pre-lamb-shorn Wool. *Wool* 2(2):13-19. L. F. Story.

Pre-lamb-shorn Wool. *Wool Record* 86:244. L. F. Story.

RESEARCH INSTITUTE OF LAUNDERERS, DRYCLEANERS, AND DYERS OF NEW ZEALAND (INC.)

Research Officer: Mr P. CARLYON COATES

PROJECTS

Survey of commercial laundries and drycleaning plants.

Investigation of causes of textile damage in articles processed in laundries and drycleaning plants.

Investigation into causes of stains and methods of removal.

Process tests in commercial and institutional laundries.

Examination of serviceability of new fabrics in relation to laundering and drycleaning.

Examination for their suitability as a filter aid in drycleaning plants of diatomaceous earths from soft currency areas.

Investigation of the resistance to drycleaning solvents of protective gloves made of synthetic rubbers.

GRANTS-IN-AID TO OTHER INSTITUTIONS

Grants for research in Universities and other institutions in 1954-55 were as follows:

	£
Auckland University College: Seagrove Radio Research Station	4,500
National Institute of Oceanography (London)	5,000
Canterbury Agricultural College	7,955
Canterbury University College—	£
Research on meteors	1,400
Industrial Development Department	8,000
	9,400
Carter Observatory	2,250
Cawthron Institute	11,133
Commonwealth Agricultural Bureaux	14,080
Dr H. H. Allan (revision of Cheeseman's <i>Manual of New Zealand Flora</i>)	375
Massey Agricultural College	6,480
Royal Society of New Zealand	4,000
Victoria University College (Radio Research)	1,000
Incorporated Research Associations	42,781
Scott Polar Research Institute	100
	£109,054

Details of projects being conducted at some of the institutions receiving grants are shown below.

CAWTHRON INSTITUTE

Director: SIR THEODORE RIGG

Aided by grants from the Department of Scientific and Industrial Research, work has been carried out on a wide range of problems connected with the tobacco, hop, fruit, and tomato industries of the Nelson district. Other important work has included entomological, soil, and plant-nutrition studies. The Institute collaborates with the Department in entomological, tobacco, and hop investigations (see Secretary's Report and under Entomological Research Station for statement of joint entomological research).

PROJECTS

Fruit Research.—Continuation of "trace" element work with apples and raspberries, observations on magnesium deficiency, recording yields on the apple stock blocks at Annesbrook orchard, and tests of raspberry varieties and manurial experiments at the Marsden Research Farm.

Hop Research.—The Institute collaborates with the Department in the conduct of joint programmes relating to the welfare of the hop industry. Investigations at the Institute comprise disease surveys; resistance tests of varieties and strains of hops, against Black Root-rot (*Phytophthora Cactorum*); chemical control of Black Root-rot; chemical analyses of hops, grown at the Hop Research Station, for sugars, resins, and dry matter; and conduct of manurial trials at the Marsden Research Farm.

Plant Nutrition.—Continuation of “trace” element studies with different Nelson crops—the studies involve chemical determinations of copper, boron, manganese, and molybdenum in both leaves and fruits.

Detailed studies of resin and sugar contents at different growth stages of hop cones; the plant food intake of hops from burring until maturity of the cones.

Soil Investigations.—Continuation of vegetation and soil surveys of the eastern foot-hill country bordering the Waimea Plains. Survey of Nelson tomato glasshouse soils for plant foods and salt contents. Establishment of molybdenum trials on pastures and farm crops to ascertain lime and molybdenum reactions on Moutere Gravel soils.

Tobacco Research.—The Institute collaborates with the Department in the conduct of tobacco research. Investigations at the Institute comprise disease surveys; resistance tests of different varieties of tobacco against *Verticillium* and *Phytophthora* diseases; chemical control of Black Root-rot (*Thielaviopsis*); and analyses of tobacco leaf samples from the fertilizer, and curing, and cultural experiments at the Tobacco Research Station.

Tomato Investigations.—Continuation of studies relating to the incidence of “Cloud” and other physiological disorders of tomatoes, effect of fertilizers on the quality of tomatoes, tests of chemical disinfectants for the treatment of glasshouse soils, and tests of introduced varieties of tomatoes for use in the Nelson industry.

PUBLICATIONS

Molybdenum Content of Nelson Soils. *N.Z. J. Sci. Tech.* A36:38–45. E. B. Kidson.

Role of Science in the Development of New Zealand Agriculture. *Pres. Address A.N.Z.A.A.S. Canberra meeting, Jan. 1954.* T. Rigg.

Biology and the Trace Elements. *Pres. Address Chemistry Sect., 8th N.Z. Science Congress.* H. O. Askew.

Chemical Changes in the Developing Hop Cone. *N.Z. Sci. Tech.* B36:227–39. H. O. Askew, R. J. Monk, and Joyce Hodgson.

The Horticultural Chemist (Pres. Address N.Z. Inst. Chemistry, Nelson, 1954). *J. N.Z. Inst. Chem.* 18:119–31. H. O. Askew.

Soils of the Nelson District by T. Rigg. Paper read at Grassland Conference Nelson 1954, reprinted by Institute.

The Effect of Position on the Bines, of Fertilizers, and of Season, on the Mineral and Nitrogen Contents of Hop Leaves and Cones. *N.Z. J. Sci. Tech.* B36:495–510. H. O. Askew, Joyce Hodgson, and G. Ward.

An Inverse Relationship between Resins and Sugar Contents of Hops. *J. Inst. Brewing.* 61:32–9. H. O. Askew and R. J. Monk.

UNIVERSITY COLLEGES

CANTERBURY AGRICULTURAL COLLEGE

Director: Dr M. M. BURNS

PROJECTS

Animal Husbandry Department.—Corriedale progeny test, fat lamb sire trials, and Border Leicester cross trials.

Farm Machinery.—Small seeds harvesting; and investigations of reactions of mounted ploughs on tractors.

Entomology Department.—Red clover pollination and seed-setting; and studies on *Thysanoptera* on cocksfoot.

Field Husbandry Department.—Pasture mixtures for light land with special reference to lucerne mixtures.

Microbiology Department.—Bacteriology of the wool fleece, food spoilage, and nitrogen-fixing bacteria.

Soils Department.—Sulphur responses on pastures, molybdenum responses on clovers, nitrogen cycle in pasture soils, and lime research.

Wool Department.—Fleece rot.

PUBLICATIONS

Nutrition and Survival of *Cercospora herpotrichoides* Fron, and Aspects of the Wheat Eyespot Disease. *N.Z. J. Sci. Tech.* A36:207–20. I. D. Blair.

The Effects and Interaction of Sulphur, Phosphorus, and Molybdenum on the Growth and Composition of Clovers. *Ibid.* A36:470–82. T. W. Walker, A. F. R. Adams, and H. D. Orchiston.

CANTERBURY COLLEGE INDUSTRIAL DEVELOPMENT DEPARTMENT

Director: Mr T. R. POLLARD

Over this period there has been a further increase in the work carried out for industry, the number of projects handled being five hundred as compared with four hundred the previous year. The total number of projects carried out for industry since 1948 is over two thousand. Government jobs showed a small increase. The financial returns from industry show a 12 per cent increase. Less work has been done in the workshop for the College. Lack of space is affecting both the economy and amount of work handled.

Dynamic balancing has become a routine matter and consideration is being given to the design of suitable apparatus for some of the firms to install. During the next few months dynamic balancing runs will be carried out for the State Hydro Department at their new Islington Substation.

Non-destructive tests have been carried out for a number of firms. A number of tests, principally for the Transport Board, have been carried out on axle assemblies and steering rocker shafts. Out of 81 axles tested, 10 have been rejected as faulty, and out of 180 steering rocker shafts 20 have been found faulty.

The design of the glass edge bevelling machine has been completed and trial runs on a temporary set up have been successfully completed. Development work has been completed on a high stability type of metal detection unit. This apparatus departs in principle from the usual type of apparatus. It is intended to install one of these units at the Forest Products Factory, Kinleith. The electronic grain counting apparatus has been made and supplied to the Australian Agricultural Department at Werrebee where it has been operating successfully. The gamma radiation detector for the indication of solid content in the effluent of the dredge Canterbury is nearly complete and will be installed shortly. A second servo-mechanism control has been supplied to the Agricultural Department at Wallaceville. A number of special scientific instruments, both physical and electronic, have been developed and made for various College departments.

MASSEY AGRICULTURAL COLLEGE

Principal: Professor G. S. PEREN

PROJECTS

Wear in sheep's teeth. Leptospirosis research. Sheep parasitology: inhibition of worm parasitism; and Epidemiology of Roundworm Parasitism. Genetics of Romney sheep: Mendelian relationships; fibre type studies; and genetic correlation. Sheep-breeding experiment.

Pampas research. Pasture manuring under rotational grazing. Drainage research: mole drainage; tile drainage; and farm drainage.

Plant propagation and plant toxicity studies. Utilization of carotene by animals, particularly ruminants.

PUBLICATIONS

Presence and Absence of Pre-natal Check in Lambs' Birthcoats. *Nature* 173:878. F. W. Dry and S. K. Stephenson.

Development of the Follicle Population in N-type Sheep. *Aust. J. Agric. Res.* 5:484-9. Janet M. Ross.

Development of the Fibre Population in N-type Sheep. *Ibid.* 5:490-502. A. S. Fraser, J. M. Ross, and G. M. Wright.

Kemp Succession in N-type Sheep. *Ibid.* 5:503-10. J. M. Ross and G. M. Wright.

Some Criticisms of the Present-day Romney. *Sheepfarming Annual* (published by Massey Agricultural College). 143-54. R. A. Barton.

Some Suggested Improvements for the Present-day Romney. *Ibid.* p. 155-62. A. L. Rae.

Recent Advances in Plant Propagation. *Proc. N.Z. Science Congress* (Section 1.3) 1954. J. S. Yeates.

SEAGROVE RADIO RESEARCH STATION, AUCKLAND
UNIVERSITY COLLEGE

Research Fellow in Charge: Dr H. H. WHALE

PROJECTS

Rotating Radio Interferometer.—Observation of the reception angles in azimuth and elevation of radio signals has continued with special attention being paid to the mechanism of U.K.-N.Z. transmissions. Some work on this project has been published, and other results await publication.

Automatic Direction Finder.—The research with this apparatus is concerned with studying the rapid fluctuations in the bearing at which radio signals are received, in an attempt to relate the character of the fluctuations to ionospheric conditions.